APPENDIX J-2

Quality Assurance Project Plan

Quil Ceda Village Wastewater Treatment Plant Effluent Monitoring Program

Submitted by

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APPENDICES

ACRONYMS

CLP	Contract Laboratory Program
DI	deionized
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
LCS	Laboratory Control Standard
MCL	Maximum Contaminant Level
MS	matrix spike
MSD	matrix spike duplicate
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
PQL	Practical Quantitation Limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOW	Statement of Work
The Tribes	The Tulalip Tribes
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

1. PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) has been prepared by Parametrix, Inc. under contract to The Tulalip Tribes. The QAPP was prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans* (2001a), and follows guidance provided in *Guidance on Quality Assurance Project Plans* (EPA, 1998).

Monitoring of effluent from the Membrane Wastewater Treatment Plant for Quil Ceda Village is a significant environmental program subject to the requirements of The Tulalip Tribes' *Quality Management Plan*.

1.1 PROJECT ORGANIZATION

The activities described in this QAPP will be conducted by members of The Tulalip Tribes (The Tribes). Specific project quality assurance (QA) responsibilities for The Tribes' Wastewater Treatment Plant Effluent Monitoring Program are described in Table 1-1.

Table 1-1. Quality Assurance Responsibilities for The Tulalip Tribes' Wastewater Treatment Plant Effluent Monitoring Program

Personnel	Responsibilities
(To Be Determined) Project Manager Public Works Director The Tulalip Tribes (Telephone No. to be determined)	Oversee technical team performance to ensure successful accomplishment of the technical and QA project objectives; review QA needs and approve QA corrective action where necessary.
Tommy Gobin Project Coordinator Wastewater Treatment Plant Operator The Tulalip Tribes (Telephone No. to be determined)	Ensure all sampling and handling procedures are followed and documented, and that QA objectives are met; coordinate and participate in the sampling activities; report to the Project QA Officer any discrepancies or deviations from the QAPP; validate data; prepare reports; maintain documentation.
(To Be Determined) Project QA Officer Assistant Public Works Director The Tulalip Tribes (Telephone No. to be determined)	Direct implementation of QAPP, provide technical QA assistance, prepare QA Reports for the Project Manager, evaluate laboratory data, perform QA/QC, and prepare Data Validation Reports.
(To Be Determined) Laboratory QA Officer (Telephone No. to be determined)	Ensure that all laboratory QA objectives are met and data package QA/QC deliverables from the laboratory are correctly documented and reported.
Gina Grepo-Grove EPA Quality Assurance Officer (206) 553-1632	Review submittals to EPA. Review QAPP and SAP. Complete inspections to verify adherence to QAPP and SAP procedures.

1.2 BACKGROUND

This plan describes quality assurance measures for wastewater treatment plant effluent monitoring. Other quality plans related to this work include:

- Sampling and Analysis Plan (SAP)
- Quality Management Plan

1.3 PROJECT DESCRIPTION

Quil Ceda Village plans to discharge treated wastewater effluent into subsurface infiltration basins located on the Tribal reservation. The Tribes will use membrane technology to treat wastewater prior to infiltration. The discharge must comply with federal Drinking Water Standards. In the future, the discharge may be directed to surface water, if an NPDES Permit is obtained.

The primary objective of the monitoring program described in this QAPP is to monitor the quality of treated effluent from the Tulalip wastewater treatment plant to ensure that concentrations in the effluent do not exceed federal Drinking Water Standards or Surface Water Standards (as applicable depending upon location of the discharge). Existing groundwater monitoring wells are located along the effluent infiltration system. These wells will be used to monitor changes in groundwater levels due to effluent infiltration.

1.4 QUALITY OBJECTIVES AND CRITERIA

1.4.1 Data Quality Objectives

Data quality objectives (DQOs) specify the quality of the data required to meet the stated goals of the project and to ensure collection of representative data of known and documentable quality. All investigation activities should be conducted and documented in accordance with the specified DQOs to ensure that sufficient data of known quality are collected. DQOs for the project have been developed in accordance with the *Guidance for Data Quality Objectives Process* (EPA, 2000).

The first DQO for the project is to obtain appropriate quantitation limits so that the data generated can be compared to applicable standards. These standards are the federal maximum contaminant levels (MCLs) for drinking water. The analytical parameters and quantitation limits are specified in the SAP, and in Section 2.4, Analytical Methods.

A second project DQO is that measurement performance criteria are satisfied for precision, accuracy, representativeness, completeness, and comparability parameters (PARCC). The PARCC parameters are described below. Methods to evaluate whether the data meet the DQOs are described in Section 2.5, Quality Control. Techniques for verifying and validating the data are described in Section 4.

1.4.2 PARCC Parameters

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. It is expressed in terms of the standard deviation or relative percent difference (RPD). Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property), X, with either an accepted reference or true value, T. Accuracy can

Data reported as specified in
EPA's approval by rule authorization

be expressed as the difference between two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, or as a ratio, X/T. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations.

Accuracy and precision are determined through quality control parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, quality control (QC) check samples, and duplicates. The project DQOs for the evaluation of these parameters will be project control limits developed and provided by the laboratory based on those given in SW-846 (EPA, 1986), functional guidelines outlined by the EPA for evaluating inorganic or organic analyses (EPA, 1994a, 1994b), or statistical information provided by the laboratory. ***Annually, the Project QA Officer must obtain a list of control limits for accuracy and precision from the laboratory and provide these to the Project Coordinator for use in data validation.***

Representativeness expresses the degree to which sampling data accurately and precisely represent a characteristic of a population. Representativeness will be assessed from review of sampling records and a QA audit of monitoring activities.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total data collected. The QA objectives for completeness are:

- Data documenting groundwater levels and other operational parameters – 90 Percent.
- Data required to be reported as specified in EPA's approval by rule authorization of the effluent infiltration system or NPDES discharge permit to surface water – 100 Percent.

Comparability expresses the confidence with which one data set can be compared to another (e.g., similar sampling methods, reporting units, etc.). All measurements will be made so that results are comparable with other measurement data for similar samples and sample conditions, and with relevant action levels, criteria, or standards. The samples will be collected and analyzed using standard techniques and reporting analytical results in units consistent with EPA guidelines.

1.5 SPECIAL TRAINING/CERTIFICATION

The Project Coordinator should receive training regarding proper sampling techniques. Health and safety training in accordance with Occupational Safety and Health Administration (OSHA) regulations may be required.

The Project QA Officer should receive training regarding implementation of the QAPP, including techniques for data validation.

Monitoring Records

1.6 DOCUMENTS AND RECORDS

Project monitoring activities will be documented through the use of daily monitoring logs and other forms as noted in Table 1-2. Examples of the sampling forms are included in Appendix A.

Table 1-2. Sampling and Sample Handling Records

Record	Use	Responsibility/Requirements
Monitoring notebook	Record significant events and observations.	Maintained by sampler; must be bound; all entries must be factual, detailed, objective; entries must be signed and dated.
Sampling Data Sheet	Provide a record of each sample collected (see Appendix A).	Completed, dated, and signed by sampler; maintained in project file.
Sample Label	Accompanies sample; contains specific sample identification information.	Completed and attached to sample container by sampler.
Chain-of-Custody Form	Documents chain of custody for sample handing (see Appendix A).	Documented by sample number. Original accompanies sample. A copy is retained by QA Officer.
Chain-of-Custody Seal	Seals the sample shipment container (i.e., cooler) to prevent tampering or sample transference (see Appendix A). Individual samples do not require custody seals, unless they are to be archived, before going to the lab for possible analysis at a later date.	Completed, signed, and applied by sampler at time samples are transported.
Sampling and Analysis Request	Provides a record of each sample number, date of collection/transport, sample matrix, analytical parameters for which samples are to be analyzed (see Appendix A).	Completed by sampler at time of sampling/transport; copies distributed to laboratory project file.

1.6.1 Monitoring Records

1.6.1.1 Monitoring Logs

A bound monitoring notebook will be maintained to provide daily records of significant events and observations that occur during monitoring activities. All entries are to be made in waterproof ink, signed, and dated. Corrections will be made according to the procedures given at the end of this section.

Monitoring notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the samplers if called upon to give testimony during legal proceedings. The monitoring notebook entries should be factual, detailed, and objective. All monitoring logs and forms will be retained by the Project Coordinator and secured in a safe place.

Pages of the monitoring notebook are not to be removed, destroyed, or thrown away. Corrections will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.

If an error made on a document is assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry.

1.6.1.2 Photographs

All photographs taken of monitoring activities will be documented with the following information noted on a photo log:

- Date, time, and subject or location of photograph taken.
- Photographer.
- Weather conditions.
- Description of photograph taken.
- Reasons photograph was taken.
- Sequential number of the photograph and the film roll number.
- Viewing direction.

The photographer will review the photographs or slides when they return from developing and compare them to the log, to assure that the log and the photographs match.

1.6.2 Laboratory Records

All laboratory data packages will contain the following information:

- Cover letter.
- Chain-of-Custody forms.
- Summary of sample results.
- Summary of QC results.

The information provided in the cover letter will include:

- Laboratory name, address, and telephone number.
- Date(s) of sample receipt and number of samples received.
- Detailed description of any problems encountered with QC, analysis, shipment, or handling procedures.
- Identification of possible reasons for any QC criteria outside acceptance limits.
- Signature of laboratory representative and date certifying data results.

Following is the minimum information to be presented for each sample for each parameter or parameters group:

- Client sample number and laboratory sample number.
- Sample matrix.
- Date of extraction/preparation and date/time of analysis.
- Dilution factors.
- Sample weights/volumes used in sample preparation/analysis.
- Identification of analytical instrument.
- Analytical method.
- Detection/quantitation limits.
- Definitions of any data qualifiers used.

The minimum QC summary information to be presented for each sample for each parameters or parameter group will include:

- Surrogate standard recovery results.
- Matrix QC results (matrix spike/matrix spike duplicate, duplicate).
- Method blank results.
- Laboratory check standard results.

2. DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The wastewater effluent samples will be collected at a location representing the quality of effluent that will be discharged to the infiltration area. A schedule for data collection has been developed to ensure that sufficient samples are available during the early stages of the project to ensure representativeness and completeness, and is included in the SAP.

2.2 SAMPLING METHODS

Procedures for sample collection are presented in the SAP. Wastewater effluent samples will be collected directly into prelabeled sampling containers provided by the analytical laboratory. Therefore, no decontamination of equipment or sampling containers will be required. Each sample will be labeled, chemically preserved (if required), and sealed immediately after collection. The labels will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with waterproof tape. An example sample label is provided in Appendix A.

The following information will be given on each sample label:

- Project name and number.
- Name of sampler.
- Date and time of sample collection.
- Sample station.
- Sample number.
- Analysis required.
- Preservation.

A summary of specifications for containers, holding times, preservation, and handling for each matrix and analysis group is shown in Table 2-1.

Table 2-1. Sample Containers, Preservatives, and Holding Times

Analyses	Sample Container	Container Size (ml)	Preservation and Handling	Holding Times[a, b, c]	Sampling Method
Nitrate, nitrite, BOD_5	HDPE[d]	1,000	Cool to 4°C	48 hours	24-Hour Composite
Ammonia, TKN	HDPE	500	H_2SO_4 Cool to 4°C	28 days	24-Hour Composite
Fecal coliform, total coliform, *E. coli*	Corning	4 oz	NaOH Cool to 4°C Add 0.008% $Na_2S_2O_3$ if residual chlorine is present	24 hours	24-Hour Composite

(Table Continues)

Table 2-1. Sample Containers, Preservatives, and Holding Times (Continued)

Analyses	Sample Container	Container Size (ml)	Preservation and Handling	Holding Times[a, b, c]	Sampling Method
Total suspended solids	HDPE	1,000	Cool to 4°C	7 days	24-Hour Composite
Cyanide	HDPE	500	NaOH to pH >12 Cool to 4°C	14 days	24-Hour Composite
Metals (except mercury) hardness, alkalinity	HDPE	1,000	HNO_3 to pH <2	6 months	24-Hour Composite
Mercury	HDPE	500	HNO_3 to pH <2	28 days	24-Hour Composite
Volatile organics	Glass vial; Teflon-lined-silicon septum cap	40 x 2	Fill bottles leaving no air space; keep in dark; cool to 4°C; HCL to pH <2	7 days; 14 days if preserved	Grab
Pesticides	Amber glass with Teflon-lined lid	1,000	Cool to 4°C	7 days until extraction; 40 days after extraction until analysis	24-Hour Composite
PCBs	Amber glass with Teflon-lined lid	1,000	Cool to 4°C	7 days until extraction; 40 days after extraction until analysis	24-Hour Composite
Total petroleum hydrocarbons	Glass	1,000	Cool to 4°C	7 days	24-Hour Composite
Benzo(a)pyrene	Amber glass with Teflon-lined lid	500	None	7 days until extraction; 40 days after extraction until analysis	24-Hour Composite
Radionuclides:					
• Alpha/Beta	Plastic	1 Liter	Nitric Acid	180 days	24-Hour Composite
• $Ra^{226/228}$	Plastic	1 Liter	Nitric Acid	180 days	24-Hour Composite

[a] EPA 1983. *Methods for Chemical Analysis of Water and Wastes.*

[b] EPA 1986. *Test Methods for Evaluating Solid Waste (SW-846)*, 3rd Edition.

[c] APHA – AWWA – WPCF 1989. *Standard Methods for the Examination of Waste and Wastewater*, 17th Edition.

[d] HDPE = High-density polyethylene.

2.3 SAMPLE HANDLING AND CUSTODY

This section describes standard operating procedures for sample custody and the chain-of-custody procedures to be used for this project. These procedures ensure that the quality and integrity of the samples are maintained during collection, transportation, storage, and analysis of the samples.

2.3.1 Sample Custody

The chain-of-custody procedures used for this project provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until the completion of all required analyses. A sample is in custody if it is in any of the following places:

- In physical possession of an authorized person.
- In view of an authorized person.
- In a secured container.
- In a designated secure area.

2.3.1.1 Chain-of-Custody Form

The following information will be provided on the Chain-of-Custody Form:

- Sample identification numbers.
- Matrix type for each sample.
- Analytical methods to be performed for each sample.
- Number of containers for each sample.
- Sampling date and time for each sample.
- Names of all sampling personnel.
- Signature and dates indicating the transfer of sample custody.

An example Chain-of-Custody Form is presented in Appendix A.

2.3.1.2 Sample Custody Procedures

As few people as possible will handle the samples, and the sample custody procedures below will be followed:

- Coolers or boxes containing clean sample bottles will be sealed with a chain-of-custody tape seal (see example in Appendix A) during transport to the wastewater treatment plant (WWTP) or while in storage before use.
- The Project Coordinator or designee will be responsible for the care and custody of the samples collected until the samples are transferred or dispatched properly.
- The Project Coordinator or designee will record sample data on the Sampling Data Sheet (see example in Appendix A).
- The Project Coordinator will determine whether proper custody procedures were followed during the work and will decide if additional samples are required.

2.3.1.3 Laboratory Custody Procedures

The laboratory sample custodian will inspect the samples, sign the Chain-of-Custody Forms, and log the samples into the laboratory data management system. Sample inspection upon receipt will include the following steps to check that samples have been collected and handled according to appropriate protocols:

- Inspect the shipment for broken or leaking containers or inappropriate sample containers or caps.
- Check bottle labels against Chain-of-Custody Forms for discrepancies.
- Check holding times.
- Check for air bubbles in sample bottles for volatile organic analyses (VOAs).
- Check pH on all preserved sample bottles and add preservatives as needed to meet preservation requirements.
- Document any problems on the Chain-of-Custody Form and contact originator.

After samples have been inspected, they will be logged into the laboratory information management system. Each sample will be assigned a unique specific identification number. Additional data is then input regarding each sample, including the date and time of receipt, client identification, and analytical parameters. Each container is labeled with its identification number.

2.3.2 Transfer of Custody and Shipment

The samples will be transported and handled in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of the samples. Samples will be personally delivered by a Tulalip Tribes employee, or shipped via courier or overnight delivery service to the analytical laboratory within 24 hours of sample collection.

Sample documents will be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents will include:

- Monitoring notebooks.
- Sample data sheet.
- Sample labels.
- Chain-of-custody records.

Examples of the Sample Data Sheet, the Sample Container Label, the Chain-of-Custody Form, and Chain-of-Custody Seal are included in Appendix A.

When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Form and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Project documentation of sample custody will be verified by the Project QA Officer during regular review of the data validation package.

The following transfer of custody and shipment procedures will be followed:

- Each cooler in which samples are packed must be accompanied by a Chain-of-Custody Form. When transferring samples, the individuals relinquishing and receiving the samples must sign, date, and note the time on the Chain-of-Custody Form to document sample custody transfer.

- Shipping containers will be sealed with Chain-of-Custody Seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the Chain-of-Custody Form.

- All shipments will be accompanied by the Chain-of-Custody Form to identify the contents. The original form will accompany the shipment. The other copies will be distributed as appropriate to the Project QA Officer and Project Manager.

- If sent by mail, the package will be registered with "Return Receipt Requested." If sent by common carrier, a bill of lading will be used. Freight bills, postal services receipts, and bills of lading will be retained as part of the permanent documentation.

2.4 ANALYTICAL METHODS

Analytical methods and reporting limits for the planned analyses are provided in Table 2-2 (page 2-6). The reporting limit in most cases is equal to the Practical Quantitation Limit (PQL), or the concentration that can be reliably measured within specified limits during routine laboratory operating conditions using approved methods. Where appropriate, these procedures may be modified, based on anticipated data uses and with recognition of validation requirements, to incorporate techniques familiar to the project laboratory. The laboratory will notify the Project QA Officer of any proposed procedural changes and document these changes in the cover letter with the data reports.

Matrix interferences may make achievement of the desired detection limits and associated quality control criteria impossible. In such instances, the laboratory must report to the Project QA Officer the reason for noncompliance with quality control criteria or elevated detection limits.

2.5 QUALITY CONTROL

Quality control checks consist of measurements performed in the WWTP and laboratory. The analytical methods referenced in Section 2.4 specify routine methods required to evaluate data precision and accuracy, and determine whether the data are within the quality control limits. Guidelines for minimum samples for QA/QC sampling and laboratory analysis are summarized in Table 2-3.

Table 2-3. Guidelines for Minimum QA/QC Samples for Sampling and Laboratory Analysis

	WWTP		Laboratory					
Media	Duplicate	Transfer Blank (if necessary)	Trip Blank[a]	Matrix Duplicate[b]	Matrix Spike	Matrix Spike Duplicate[c]	Method Blank	LCS[d]
Aqueous	1 in 20,[e] or annually	1 in 20	1 per cooler	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch

a Trip blank analyzed for volatile organic compounds only.

b Matrix duplicate analyzed for metals.

c Matrix spike duplicate analyzed for organic analyses.

d Laboratory Control Sample.

e All frequencies of 1 in 20 indicate 1 per batch, when the batch is less than 20 samples.

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Instrument Parameters							
Dissolved oxygen	mg/L	NA	8.0	NA	360.2	0.1	High dissolved oxygen required for discharge to SW or fish rearing ponds.
pH	standard units	NA	6.5–9	NA	150.1	0.05	
Specific conductance	(µs/cm)	700	NA	NA	120.1	1.0	
Turbidity	NTU	NA	NA	NA	180.1	0.01	
Inorganic Compounds							
Metals[a]		Total Metal[c]	Dissolved Metal[c]	Total Metal[c]			
Antimony	mg/L	0.006	NA	4.3	200.8/200.7[d]	0.005	
Arsenic	mg/L	0.01 (total Cr)	0.34 (0.15)	0.14	200.8/200.7	0.001	SW standard applicable to both total and dissolved arsenic.
Barium	mg/L	2	NA	NA	200.8/200.7	0.005	
Beryllium	mg/L	0.004	NA	See footnote[e]	200.8/200.7	0.001	
Cadmium	mg/L	0.005	0.0043 (0.0022)	See footnote[e]	200.8/200.7	0.001	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Chromium (III)	mg/L	0.1 (total Cr)	0.57 (0.074)	See footnote[e]	200.8/200.7	0.005	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Copper	mg/L	1.3	0.013 (0.009)	NA	200.8/200.7	0.005	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Lead	mg/L	0.015	0.065 (0.0025)	See footnote[e]	200.8/200.7	0.001	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Mercury	mg/L	0.002	0.0014 (0.00077)	0.000051[e]	245.1	0.0001[f]	
Nickel	mg/L	0.1	0.47 (0.052)	4.6[e]	200.8/200.7	0.01	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Selenium	mg/L	0.05	See Comment (0.005)	11[e]	200.8/200.7	0.005	CMC = 1/[(f1/CMC1)+(f2/CMC2)] Where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, and CMC1 and CMC2 are 0.1859 and 0.01283 mg/L, respectively. For this project, criteria will be compared to total selenium x 0.922 as allowed by the standards, unless required otherwise due to elevated concentrations of total selenium.

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Silver	mg/L	0.002	3.4 (None)	NA	200.8/200.7	0.002	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Thallium	mg/L	0.002	NA	0.0063[e]	200.8/200.7	0.002	
Zinc	mg/L	5	0.120 (0.120)	69[e]	200.7 or equivalent	0.006	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Conventional Parameters							
Alkalinity	mg/L	NA	>20	NA	310.1	1.0	
Ammonia (as N)	mg/L	NA	See Comment	NA	350.1	0.01	SW standard is pH dependent. See Appendix B.
BOD5	mg/L	NA	NA[e]	NA	405.1	1.0	
Cyanide	mg/L	0.2	0.022 (0.0052)	220	335.2/335.3	0.005	As free cyanide.
Hardness	mg/L	NA	NA	NA	200.7	0.5	
Nitrate	mg/L	10 (as N)	NA	NA	300.0	0.01	
Nitrite	mg/L	1 (as N)	NA	NA	300.0	0.01	
Phosphorus	mg/L	NA	NA[e]	NA	365.2	0.008	
TKN	mg/L	NA	NA	NA	351.2	0.1	
Total Suspended Solids	mg/L	NA	NA	NA	160.2	1.0	

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Microbiological Tests							
Fecal coliform	MPN/100 mL	0	NA	NA	9221B	1	
E. coli	MPN/100 mL	0	100[g]	14[h]	9221F	1	
Total coliforms	MPN/100 mL	0	NA	NA	9221E	1	
Organic Compounds							
Benzene	mg/L	0.005	NA	0.071	524.2	0.00025	
Carbon tetrachloride	mg/L	0.005	NA	0.0044	524.2	0.00025	
Chlorobenzene	mg/L	0.1	NA	21	524.2	0.00025	
Dibromochloro-3-propane	mg/L	0.0002	NA	NA	504.1	0.0002	
Dichlorobenzene, 1,2-	mg/L	0.6	NA	NA	524.2	0.00025	
Dichlorobenzene, 1,4-	mg/L	0.075	NA	NA	524.2	0.00025	
Dichloroethane, 1,2-	mg/L	0.005	NA	0.099	524.2	0.00025	
Dichloroethene, 1, 1-	mg/L	0.007	NA	0.0032	524.2	0.00025	
Dichloroethene, cis-1,2-	mg/L	0.07	NA	NA	524.2	0.00025	
Dichloropropane, 1,2-	mg/L	0.005	NA	NA	524.2	0.00025	
Dichloromethane	mg/L	0.005	NA	NA	524.2	0.00025	
Dichloroethene, trans-1,2-	mg/L	0.1	NA	NA	524.2	0.00025	
Ethyl benzene	mg/L	0.7	NA	29.0	524.2	0.00025	
Ethylene dibromide (EDB)	mg/L	0.00005	NA	NA	524.2	0.00025	
Hexachlorobenzene	mg/L	0.001	NA	NA	524.2	0.00025	
Styrene	mg/L	0.1	NA	NA	524.2	0.00025	
Tetrachloroethene	mg/L	0.005	NA	0.00885	524.2	0.00025	
Toluene	mg/L	1.0	NA	200	524.2	0.00025	

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
1,2,4-trichlorobenzene	mg/L	0.07	NA	NA	524.2	0.00025	
1,1,1-trichloroethane	mg/L	0.2	NA	See footnote[e]	524.2	0.00025	
1,1,2-trichloroethane	mg/L	0.005	NA	0.042	524.2	0.00025	
Trichloroethene	mg/L	0.005	NA	0.081	524.2	0.00025	
Vinyl chloride	mg/L	0.002	NA	0.525	524.2	0.00025	
Xylenes (total)	mg/L	10	NA	NA	524.2	0.00025	
Pesticides							
Chlordane	mg/L	0.002	0.0000043	0.0000022	508A	0.00005[f]	Reporting limits of 0.0000025 are theoretically achievable for each of these compounds under ideal conditions.
Heptachlor	mg/L	0.0004	0.0000038	0.00000021	508A	0.00005[f]	
Heptachlor epoxide	mg/L	0.0002	0.0000038	0.00000011	508A	0.00005[f]	
Lindane	mg/L	0.0002	0.000095	0.000063	508A	0.00005	
Methoxychlor	mg/L	0.04	NA	NA	508A	0.00005	
PCBs							
Aroclor 1016	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	Reporting limit of 0.000017 is theoretically achievable for all aroclors under ideal conditions.
Aroclor 1221	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1232	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1242	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1248	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1253	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1260	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Total PCBs	mg/L	NA	NA	0.000017	NA	NA	Calculate as sum of detected aroclors[f].

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Total TPH							
NW-TPH-G	mg/L	MTCA	NA	NA	WDOE Method	1.0	
NW-TPHD extended	mg/L	MTCA			WDOE Method	1.0	
Benzo(a)pyrene	mg/L	0.0002	NA	0.000049	8270-SIM	0.0001 mg/L	
Radionuclides							
• Alpha	pCi/L	15	NA	NA	EPA 900.0	1 pCi/L	
• Beta	mrem/yr	4	NA	NA	EPA 900.0	2 pCi/L	
• Alpha/Beta			NA	NA	EPA 900.0		
• $Ra^{226/228}$	pCi/L	5	NA	NA	calculated	1 pCi/L	
• Ra^{226}			NA	NA	EPA 903.0	0.2 pCi/L	
• RA^{228}			NA	NA	EPA 904.0	1 pCi/L	

Note: NA = Not applicable, MTCA = Model Toxics Control Act, WDOE = Washington State Department of Ecology

a Metals concentrations will be tested as total recoverable metals unless concentrations exceed an applicable surface water criteria, in which case dissolved concentrations will be analyzed.

b Per National Recommended Water Quality Criteria – Correction, EPA822-Z-99-001, April 1999. Valve shown is acute concentration. Valve shown in parentheses is chronic concentration.

c MCLs are applied as total metals, surface water standards are applied as dissolved metals.

d Use 200.7 when the analyte is detected 5x higher than the Method Detection Limit.

e Development of a site-specific discharge limit may be necessary if effluent is used for fish rearing.

f Lowest practical reporting limit.

g Proposed criterion.

h Applicable to shellfish only.

2.5.1 WWTP Methods

The following quality control samples will be evaluated to verify accuracy and precision of laboratory results for this project. The frequency of quality control sample evaluation may be adjusted when the final sampling schedule is determined. The frequencies of quality control sample evaluation described here should be considered a minimum.

2.5.1.1 Trip Blank

A minimum of one trip blank will be analyzed each sampling event for volatile organic compounds (VOCs). There should be one trip blank in each cooler used to ship VOC samples to the laboratory. The trip blank will consist of a purged-free deionized (DI)/distilled water blank supplied by the analytical laboratory. It will be transported to and from the WWTP, then returned to the laboratory unopened and unaltered for analysis. The term "purged-free" water refers to DI/ distilled water that has been boiled and capped in the laboratory. Transfer blanks will be analyzed if contaminants are found in the trip blank to determine if contamination is due to possible container contamination.

2.5.1.2 Transfer Blank

Transfer blanks will be collected and analyzed if the source of trip blank contamination cannot be discovered. The transfer blank will consist of DI/distilled water (supplied by the analytical laboratory) transferred in the WWTP into the appropriate sampling containers. The transfer blank will evaluate possible sample contamination from the sampling event.

2.5.1.3 Duplicate

A minimum of one blind duplicate will be analyzed per 20 samples, or one annually (whichever is greater), to verify the precision of laboratory and/or sampling methodology. The duplicates for samples will be collected sequentially. The samples will be coded so the laboratory cannot discern which samples are duplicates.

2.5.2 Laboratory Methods

Specific procedures and frequencies for laboratory quality control are detailed by analytical method in the laboratory QA Plan. A general description of the types of required laboratory QC samples is provided below.

2.5.2.1 Method Blank

A minimum of one laboratory method blank will be analyzed per 20 samples or one per batch (whichever is greater), to assess possible laboratory contamination. Method blanks will be spiked with surrogate compounds prior to analysis and undergo all procedural steps used for analysis of routine samples.

2.5.2.2 Control Sample

A minimum of one laboratory control standard (LCS) per 20 samples or one per sampling event (whichever is greater) will be analyzed for inorganics to verify precision of laboratory equipment. The LCS will be a concentration within the calibration range at a different concentration than the standards used to establish the calibration curve. LCS analysis will follow EPA LCS guidelines established in SW-846 (EPA, 1986).

2.5.2.3 Matrix Spike

A minimum of one laboratory matrix spike (MS) per 20 samples will be analyzed for VOCs, or one per sampling event (whichever is greater), to monitor recoveries and assure that extraction and concentration levels are acceptable for QA/QC review. The laboratory matrix spike will follow the matrix spike guidelines specified in the Contract Laboratory Program (CLP) Statements of Work (SOWs) (EPA, 1993a, 1993b).

2.5.2.4 Matrix Spike Duplicate

A minimum of one laboratory matrix spike duplicate (MSD) per 20 samples will be analyzed for VOCs, or one per sampling event (whichever is greater), to provide information on the precision of chemical analysis. MSDs (rather than matrix duplicates) apply to organic analyses because of the large number of undetected compounds. Comparing the MS and MSD provides better information on the quality of the data. The laboratory matrix spike duplicate will follow EPA matrix spike duplicate guidelines specified in SW-846 (EPA, 1986).

2.5.2.5 Matrix Duplicate

A minimum of one laboratory matrix duplicate will be analyzed per 20 samples, or one per sampling batch (whichever is greater), when samples are analyzed for metals and conventionals, to provide information on the precision of chemical analysis. The laboratory duplicate will follow EPA duplicate guidelines specified in the SW-846 (EPA, 1986).

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

2.6.1 Field Monitoring Instruments

The Project Coordinator will arrange for instrumentation preventive maintenance. Preventive maintenance on monitoring instruments will be performed by qualified technicians following the manufacturer's instructions and maintenance schedules and the analytical method procedures and frequencies. Maintenance will be documented in instrument logbooks with the date and initials of the individual performing the maintenance.

The Project Coordinator will routinely review and compare instrument calibration results against the preventive maintenance records to verify the effectiveness of the preventive maintenance program. The Project Coordinator will track scheduling of preventive maintenance required by the manufacturer.

2.6.2 Laboratory Instruments

The analytical laboratory manager is ultimately responsible for the care of the laboratory instruments. He or she may delegate the responsibility to the senior supervising chemists or technicians qualified to perform routine maintenance, after demonstrating that personnel are trained in maintenance procedures for that laboratory section (wet chemistry, metals, and organics). Laboratory analysts shall be experienced in the field of instrumentation, analytical methods, data reduction, and data interpretation.

Maintenance and other appropriate details will be documented in daily maintenance logbooks. The individual performing the maintenance procedures will date and sign each entry. At a minimum, the preventive maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

2.7.1 Field Monitoring Instruments

Monitoring instruments will be calibrated according to manufacturer's instructions. All instruments to be used will be calibrated on a daily basis, when used. The following data will be recorded on appropriate forms:

- Date.
- Project number.
- Instrument make and model number.
- Instrument response during calibration.

2.7.2 Laboratory Instruments

All instruments and equipment used during analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, and in accordance with procedures in the analytical method cited, as documented in the laboratory QA Plan. Properly trained personnel will operate, calibrate, and maintain laboratory instruments. Calibration blanks and check standards will be analyzed daily for each parameter to verify instrument performance and calibration before beginning sample analysis.

Where applicable, all calibration procedures will meet EPA CLP protocols (EPA, 1993a, 1993b). Any variations from these procedures must be approved by the Project QA Officer before beginning sample analysis. Acceptance criteria shall be as set forth in the most current revision of EPA CLP Statements of Work OLM04.2 (5/99) for organic analyses and ILM05.2 (12/01) for inorganic analyses.

After the instruments are calibrated and standardized within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. Acceptable performance of the QC check sample verifies the instrument performance on a daily basis. Analysis of a QC check standard is also required. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check samples will be analyzed and evaluated according to the EPA method criteria.

Instrument performance check standards and calibration blank results will be recorded in a laboratory instrument logbook that will also contain evaluation parameters, benchmark criteria, and maintenance information. If the instrument logbook does not provide maintenance information, a separate maintenance logbook will be maintained for the instrument.

2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Consumables for this project include laboratory-supplied sampling containers, deionized water used for blanks, and calibration standards for monitoring instruments. The Project Coordinator will be responsible for accepting, inspecting, and tracking consumables using appropriate developed forms. Records for calibration standards should include, at a minimum, source of procurement, concentration, and expiration date.

2.9 NON-DIRECT MEASUREMENTS

Non-measurement sources such as computer databases, programs, literature files, and historical databases are not expected to be required in this project.

2.10 DATA MANAGEMENT

This section contains a description of data management procedures, including sample identification, data handling, and data storage. The objectives of the data management plan are to assure that large volumes of information and data are technically complete, accessible, and efficiently handled.

2.10.1 Laboratory Data

Data (including instrument calibrations, chromatograms, and mass spectra), procedural logs for each instrument, sample extraction and preparation logs, and standard preparation logs will be kept on file at the laboratory.

Sample and QC results will be stored in a database maintained by the analytical laboratory. Data will be provided by the laboratory in electronic format for direct input into the project database.

2.10.2 Wastewater Treatment Plant Data

Techniques to assign sample identification numbers and to manage and analyze analytical data generated by the laboratories are described below. Prior to the sampling event, each sample location will be assigned a unique code. Each sample collected at that location will be preassigned an identification code using the sample location followed by other specific information describing the sample. The following example illustrates the sample identification system:

EF-122002-001-0

Where:

EF	=	Effluent
122002	=	Date
001	=	Station number
0	=	Code indicating whether the sample is a duplicate, where 0 is assigned for the sample, and 1 is assigned for a duplicate sample

Where appropriate, sample labels and forms will be preprinted with the appropriate sample identification code.

2.10.3 Office Data

2.10.3.1 Hard Copy Data

The original hard (paper) copies of all notes and laboratory reports will be stored in the project file in standard metal file cabinets. Photocopies of these documents should be prepared for working copies as needed.

Data should be recorded in bound notebooks or individual sampling sheets. The sampler should review the data for completeness prior to placing it in the files.

2.10.3.2 Electronic Data

All data will be stored in the project database. Instrument data (pH, specific conductivity, dissolved oxygen, turbidity) will be added from the monitoring notebook or Sampling Data Sheets by direct data entry, or will be handled electronically. Laboratory analytical results will be added by direct transfer from the laboratory on computer disk.

The project database will contain a minimum of three files: Results, Sample, and Chemical. A list of fields that each of these files will contain is presented in Attachment A. The Results file will store data related to the analytical test results, including the value, units, data qualifiers, analytical method, and date analyzed. The Sample file will relate the sample identification number to the sampling location, date, and time sampled. The Chemical file will contain information about each of the chemicals tested, including the chemical name, Chemical Abstract Service (CAS) number, and applicable regulatory criteria.

The specific steps involved in the electronic data management process are outlined below.

1. Obtain analytical data results from the testing laboratory in electronic format on computer disk.
2. Conduct QA/QC data validation of analytical data according to procedures described in the project QAPP.
3. Inspect electronic data for accuracy and completeness.
4. Add additional data qualifier codes, if required, to electronic data file.
5. Enter data into data file; check data entry 100 percent against data sheets or monitoring notebook.
6. Create Sample file and enter information from monitoring notebook or Sampling Data Sheets (e.g., sampling date, time, etc.).
7. Append Results file and Sample file to project database.
8. Generate data summary tables; check 10 percent against hard copy.
9. Output data for required analyses such as statistical evaluation.

The database will be stored in a central network location that will be accessible via password to authorized project personnel. The database will be backed up on a weekly basis.

To export data for use with other software tools, data will be extracted from the project database by making queries. The file will then be exported into a neutral format (e.g., delimited ASCII) or to a format specific to the analysis package. Examples of data analysis tools that may be used for the project include graphical representations (e.g., GIS), statistical analysis (e.g., SAS), and contouring (e.g., Surfer for Windows).

2.11 REPORTS TO MANAGEMENT

Quarterly, the Project Coordinator must prepare a quality report for the Project Manager describing adherence to the requirements of the SAP and QAPP, results of data validation, significant problems identified, corrective actions taken, and recommendations for improvements. The report should also be provided to the Project QA Officer.

3. ASSESSMENT AND OVERSIGHT

3.1 ASSESSMENTS AND RESPONSE ACTIONS

3.1.1 Audits

Performance and system audits will be performed at least annually by the Project QA Officer. Audits will consist of direct observation of work being performed and inspection of WWTP and laboratory equipment. The performance and system audits will also review the sample custody procedures in the WWTP and laboratory.

If implemented, internal audits of both the WWTP and laboratory activities will be conducted by the Project QA Officer. Audits will be unannounced to assure a true representation of the technical and QA procedures employed.

Checklists for both WWTP and laboratory audits will be based on National Enforcement Investigation Center (EPA, 1984) audit checklists. The audits will be performed by persons having no direct responsibilities for the activities being performed.

Before the internal audit, the auditor(s) will meet with the audited party and define the scope of the audit. The actual audit will consist of reviewing audited activities, completing the checklist, noting any nonconformances or deficiencies, and other relevant observations. An exit interview will be conducted with the audited party to notify them of preliminary audit findings.

The auditor or designee will prepare an audit report that includes findings, nonconformances, observations, and recommended corrective action with a schedule for completion of such action. The audit report format is shown in Table 3-1.

Table 3-1. Audit Report Format

Item	Description
1.	Purpose of Audit
2.	Audit Basis
3.	Time and Place of Audit
4.	Personnel Contacted
5.	Audit Team Members
6.	Summary of Events
7.	Findings and Recommendations
	a. Positive Findings
	b. Negative Findings
8.	Required Follow-up (responsible parties, summary of required corrective action, date of re-audit, if required)
9.	Distribution of Audit Report and Corrective Action Reports

3.1.2 Corrective Action

For each identified nonconformance, a corrective action report will be issued as part of the audit report to notify the individual responsible for implementing the recommended corrective action and its schedule for completion. If a corrective action is required, the Project Manager will be notified. If a laboratory corrective action is required, the Laboratory QA Officer will be notified. The audit will be distributed to the Project Manager.

The audit will remain open until all corrective action is completed by the responsible party and approved by the Project QA Officer. Once all findings are corrected and documented on Corrective Action Reports, the audit is closed by the Project QA Officer. An audit may be closed either by a memo filed with the audit report or by other appropriate methods.

Corrective actions may be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in the SAP or QAPP.
- Equipment or analytical malfunctions.

During WWTP operations and sampling procedures, the Project Coordinator will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the monitoring notebook. If conditions are such that conformance with the SAP or QAPP is not possible, the Project QA Officer will be consulted immediately. Any corrective action or condition resulting in a major revision of the QAPP will be communicated to the Project Manager for review and concurrence. Whenever possible, this communication will be made before changes in monitoring procedures are implemented.

During laboratory analysis, the Laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in the QAPP, corrective action will follow the guidelines in SW-846 (EPA, 1986). This includes, at a minimum, the following considerations:

- Calibration check compounds must be within performance criteria specified in the most current revision of EPA CLP Statements of Work OLM04.2 (5/99) and ILM05.2 (12/01) or corrective action must be taken before sample analysis begins.
- Before processing any samples, the analyst will demonstrate by analysis of a reagent blank that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank will be processed as a safeguard against chronic laboratory contamination. The blank samples will be carried through all stages of the sample preparation and measurement steps.
- Surrogate spike analysis must be within the contract required recovery limits or corrective action must be taken and documented.

If analytical conditions do not conform with this QAPP, the Project QA Officer will be notified as soon as possible so that additional corrective actions can be taken.

Corrective Action Reports will document response to any reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities.

Corrective Action Reports will be review for appropriateness of recommendations and actions by the Project QA Officer for QA matters, and the Project Manager for matters of technical approach.

3.2 REPORTS TO MANAGEMENT

The Project QA Officer will be responsible for data quality assessments and associated QA reports. A Data Validation Report will be prepared by the Project QA Officer (see Section 4.3) and will accompany all data packages. This report will summarize all relevant data quality information and will discuss the usability of the data. Final task or investigative reports will contain a separate QA section summarizing data quality information.

4. DATA VALIDATION AND USABILITY

Verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation is also confirmation by examination and provision of objective evidence that the particular requirement for a specific intended use have been fulfilled. Techniques for data verification and validation will be in accordance with the *Guidance on Environmental Data Validation and Verification* (EPA, 2001b).

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Analytical data will be reviewed by the Laboratory QA Officer to assure that the QA/QC objectives for precision, accuracy, representativeness, completeness, and comparability have been met. These reviews will identify the occurrence of deficiencies in time to take corrective action. If the required QC objectives are not met after the corrective action is performed, the Project QA Officer will be notified by the Laboratory QA Officer before data submittal. The Project QA Officer will determine if additional corrective action should be taken, such as re-analysis, if applicable.

The project control limits for acceptable precision and accuracy will be those developed by the selected laboratory based on the specified methods of the current revision of EPA CLP Statements of Work OLM04.2 (5/99) and ILM05.2 (12/01). All data packages provided by the laboratory must include a summary of quality control results adequate to enable reviewers to validate or determine the quality of the data.

The Project QA Officer is responsible for conducting checks for internal consistency, transmittal errors, and for adherence to the quality control elements specified in Section 2.5 of the QAPP. The Project QA Manager will review the data package submitted by the laboratory to ensure that documentation has been provided (as described in Section 1.6.2), appropriate QC checks have been performed, and that appropriate corrective actions have been taken. Data validations will be performed in accordance with the technical specifications of the analytical methods and the *National Functional Guidance for Organic and Inorganic Data Review* (1999, 1994). The Project QA Manager will then determine the potential effects of any deviations or corrective actions on the suitability of the data.

Duplicate samples will be analyzed as QC samples for verification of precision and accuracy. Verification of accuracy and precision will also be determined by evaluating surrogate recoveries, matrix spike and matrix spike recoveries, and relative percent differences (RPDs), QC check recoveries, LCS recoveries, serial dilution results, and triplicate results (conventionals). If the results of the duplicates are outside the control limits, corrective action and/or data qualification will be determined after review by the Project QA Officer. Results of duplicate sample can be of poor quality because of sample heterogeneity. Therefore, corrective action will be determined by the Project QA Officer and discussed in the Data Validation Report.

Instrument measurements (pH, specific conductance, and temperature) will be verified and checked through review of instrument calibration, measurement, and recording procedures.

4.2 VERIFICATION AND VALIDATION METHODS

This section describes routine procedures for assessing project data. The Project QA Officer will review the following quality control data results for all samples:

- Chain-of-custody documentation.
- Holding times.
- Trip blanks.
- Rinsate blanks.
- Transfer blanks.
- Duplicates.
- Method blanks.

A limited review (minimum 10 percent) of the following quality control data results will be conducted:

- Laboratory matrix spike/matrix spike duplicate and/or matrix duplicate results.
- Laboratory surrogate recoveries.
- Laboratory check samples.

If, based on this limited review, the quality control data results indicate potential data quality problems, further evaluations will be conducted.

4.2.1 Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that measure precision include duplicates, matrix spike duplicates, and matrix duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), which is calculated:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2) \div 2} \times 100$$

Where:

D_1 = First sample value

D_2 = Second sample value

The RPDs will be routinely calculated and compared with DQOs. Control limits are established by determining the standard deviation of a series of replicate measurements.

4.2.2 Accuracy

Accuracy is assessed using the results of standard reference material, linear check samples, and matrix spike analyses. It is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against DQOs.

4.2.3 Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with the data quality objectives.

4.2.4 Representativeness

Sample locations and sampling procedures will be chosen to maximize representativeness. A qualitative assessment (based on professional experience and judgment) will be made of sample data representativeness based on review of sampling records and QA audit of monitoring activities.

4.3 RECONCILIATION AND USER REQUIREMENTS

The Project QA Officer will prepare a Data Validation Report for each data package describing the results of the data validation and describing any qualifiers that were added to the data. The memorandum will include recommendations on whether additional actions such as resampling are necessary. The Data Validation Report will be submitted to the Project Manager and EPA Project Manager.

5. REFERENCES

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APPENDIX A

Sampling Forms

Chain of Custody Record & Laboratory Analysis Request

Page ____________ of ____________

Number of coolers: ____________

Cooler Temp: ________________

Analytical Resources, Incorporated
Analytical Chemist and Consultants
400 Ninth Avenue North
Seattle, WA 98109-4708
(206) 621-6490
(206) 621-7523 (Fax)

ARI Client: | Phone#:

Client Contact:

Client Project ID:

Samplers:

	Sample ID	Date	Time	Matx	No Cont	Lab ID	Analysis Required								Notes/Comments
1															
2															
3															
4															
5															
6															
7															

ARI Project No:	Relinquished by: (Signature)	Relinquished by: (Signature)	Relinquished by: (Signature)
T.A.T. Requested:	Printed Name:	Printed Name:	Printed Name:
Comments/Special Instructions:	Company:	Company:	Company:
	Date: Time:	Date: Time:	Date: Time:
	Received by: (Signature)	Received by: (Signature)	Received by: (Signature)
	Printed Name:	Printed Name:	Printed Name:
	Company:	Company:	Company:
	Date: Time:	Date: Time:	Date: Time:

Chain of Custody

CLIENT ____

DATE ____

Parametrix, Inc.

Parametrix, Inc.

Client: ____________ Project: ____________

Sample ____________ Site ____________

Date ________ Time ________ Sampler ________

Analysis ____________________________

Comments: ____________________________

____

Well #: ______
Sample #: ______

Groundwater Sampling Field Data Sheet

Project Number: ______ Date: ______
Project Name: ______ Location: ______
Project Address: ______ Sampled By: ______
Client Name: ______ Purged By: ______

Casing Diameter: 2" ______ 4" ______ 6" ______ Other ______

Depth to Water (feet): ______
Depth of Well (feet): ______
Reference Point (surveyors notch, etc.): ______
Date/Time Sampled: ______
Purge Volume Measurement Method: ______
Date Purged: ______
Purge Time (from/to): ______

Purge Volume Calculation: $(\pi r^2 h)(7.48\ gal/ft^3)$(5 casing volumes)
Purge Volume (gallons) for: 2" = (0.80)(h); 4" = (3.26)(h); 6" = (7.40)(h)
Calculated Purge Volume (gallons): ______ Actual Purge Volume (gallons): ______

TIME (2400 hr)	CUMULATIVE VOLUME (gal)	PH (units)	Ec (µmhos/cm 25° c)	COLOR (visual)	TURBIDITY (visual)	ODOR	OTHER

Purging Equipment: ______ Sampling Equipment: ______

Laboratory: ______ Date Sent to Lab: ______
Chain-of-Custody (yes/no): ______ Field QC Sample Number: ______
Shipment Method: ______ Split with (name(s)/organization(s): ______

Well Integrity: ______
Remarks: ______

Signature: ______ Page ____ of ______

Field Report / Well Data

DATE	JOB NO.
PROJECT	
LOCATION	
CONTRACTOR	OWNER
WEATHER	TEMP °at AM °at PM
PRESENT AT SITE	

TO:

THE FOLLOWING WAS NOTED:

WN (WELL NUMBER)	TIME	DTW (DEPTH TO WATER)	MP (MEASURE POINT)	SU (STICK UP OF WELL CASING)	TD (TOTAL DEPTH OF WELL)	WD (WELL DIAMETER)

TOC (Top of Locking Casing) TOW (Top of Well Casing)

Parametrix, Inc.

COPIES TO:

SIGNED

Field Report

DATE	JOB NO.
PROJECT	
LOCATION	
CONTRACTOR	OWNER
WEATHER	TEMP ° at AM ° at PM
PRESENT AT SITE	

TO

THE FOLLOWING WAS NOTED:

COPIES TO:

SIGNED

Parametrix, Inc.

Sample . yses Tracking Report

PAGE ____ F ____

PROJECT NAME ______________________ PROJECT NO. ______________ CLIENT ______________

PMX SAMPLE NO.	SAMPLE DESCRIPTION	SAMPLING DATE/TIME	DATE SAMPLE SHIPPED	DATE/TIME LAB CONTACTED FOR SHIPMENT	DATE ANALYTICAL DATA RECEIVED	LABORATORY INVOICE NO.	DATE QUALITY ASSURED	DATE DATA SENT TO CLIENT	COMMENTS

APPENDIX B

Calculation of Hardness and pH Dependent Surface Water Standards

CALCULATION OF HARDNESS DEPENDENT SURFACE WATER STANDARDS

Parameters for calculating Freshwater Dissolved Metals Criteria that are hardness-dependent are provided in the table on the following page. Calculate actual standard per Appendix C.

Maximum Criteria Concentration: $CMC = CF \times \exp\{m_A[\ln(\text{hardness})]+b_A\}$

Continuous Criteria Concentration: $CCC = CF \times \exp\{m_C[\ln(\text{hardness})]+b_C\}$

With hardness expressed in mg/L.

Conversion factors (total versus dissolved concentrations) are also attached.

United States
Environmental Protection
Agency

Office of Water
4304

EPA 822-Z-99-001
April 1999

EPA

National Recommended Water Quality Criteria–Correction

Appendix A - Conversion Factors for Dissolved Metals

Metal	Conversion Factor freshwater CMC	Conversion Factor freshwater CCC	Conversion Factor saltwater CMC	Conversion Factor saltwater CCC[1]
Arsenic	1.000	1.000	1.000	1.000
Cadmium	1.136672-[(ln hardness)(0.041838)]	1.101672-[(ln hardness)(0.041838)]	0.994	0.994
Chromium III	0.316	0.860	--	--
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	1.46203-[(ln hardness)(0.145712)]	1.46203-[(ln hardness)(0.145712)]	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	--	--	0.998	0.998
Silver	0.85	--	0.85	--
Zinc	0.978	0.986	0.946	0.946

Appendix B - Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	m_A	b_A	m_C	b_C	Freshwater Conversion Factors (CF)	
					Acute	Chronic
Cadmium	1.128	-3.6867	0.7852	-2.715	1.136672-[ln (hardness)(0.041838)]	1.101672-[ln (hardness)(0.041838)]
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960
Lead	1.273	-1.460	1.273	-4.705	1.46203-[ln (hardness)(0.145712)]	1.46203-[ln (hardness)(0.145712)]
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.52	--	--	0.85	--
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Appendix C - Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC calculated using the following equation:

$$CMC = \frac{0.275}{1 + 10^{7.204-pH}} + \frac{39.0}{1 + 10^{pH-7.204}}$$

In situations where salmonids do not occur, the CMC may be calculated using the following equation:

$$CMC = \frac{0.411}{1 + 10^{7.204-pH}} + \frac{58.4}{1 + 10^{pH-7.204}}$$

2. The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CCC calculated using the following equation:

$$CCC = \frac{0.0858}{1 + 10^{7.688-pH}} + \frac{3.70}{1 + 10^{pH-7.688}}$$

and the highest four-day average within the 30-day period does not exceed twice the CCC.

Federal Freshwater Dissolved Metal Criteria That Are Hardness Dependent 07-May-02

Data Values Per EPA 822-Z-99-001 4/99

Parameter	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
mA	1.1280	0.8190	0.9422	1.2730	0.8460	1.7200	0.8473
bA	-3.6867	3.7256	-1.7000	-1.4600	2.2550	-6.5200	0.8840
mc	0.7852	0.8190	0.8545	1.2730	0.8460	NA	0.8473
bc	-2.7150	0.6848	-1.7020	-4.7050	0.0584	NA	0.8840
Acute CF	Calc	0.3160	0.9600	Calc	0.9980	0.8500	0.9780
Chronic CF	Calc	0.8600	0.9600	Calc	0.9970	1.0000	0.9860

	Cadmium		Lead	
Hardness	Conversion Factors (CF)		Conversion Factors (CF)	
(mg/L)	Acute	Chronic	Acute	Chronic
10	1.0403	1.0053	1.1265	1.1265
20	1.0113	0.9763	1.0255	1.0255
30	0.9944	0.9594	0.9664	0.9664
40	0.9823	0.9473	0.9245	0.9245
50	0.9730	0.9380	0.8920	0.8920
60	0.9654	0.9304	0.8654	0.8654
70	0.9589	0.9239	0.8430	0.8430
80	0.9533	0.9183	0.8235	0.8235
90	0.9484	0.9134	0.8064	0.8064
100	0.9440	0.9090	0.7910	0.7910
110	0.9400	0.9050	0.7771	0.7771
120	0.9364	0.9014	0.7644	0.7644
130	0.9330	0.8980	0.7528	0.7528
140	0.9299	0.8949	0.7420	0.7420
150	0.9270	0.8920	0.7319	0.7319
160	0.9243	0.8893	0.7225	0.7225
170	0.9218	0.8868	0.7137	0.7137
180	0.9194	0.8844	0.7054	0.7054
190	0.9171	0.8821	0.6975	0.6975
200	0.9150	0.8800	0.6900	0.6900

Calculated Acute Freshwater Criteria, ug/L
Based on Dissolved Metal Concentration

Hardness (mg/L)	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
10	0.350	86.4	1.54	4.91	66.8	0.066	16.7
20	0.744	152	2.95	10.79	120	0.22	30.0
30	1.16	213	4.32	17.04	169	0.43	42.2
40	1.58	269	5.67	23.51	216	0.71	53.9
50	2.01	323	6.99	30.14	260	1.05	65.1
60	2.45	375	8.31	36.88	304	1.43	76.0
70	2.90	425	9.60	43.71	346	1.87	86.6
80	3.35	475	10.9	50.61	388	2.35	97.0
90	3.80	523	12.2	57.57	428	2.88	107
100	4.26	570	13.4	64.58	468	3.45	117
110	4.73	616	14.7	71.63	508	4.06	127
120	5.20	662	16.0	78.72	546	4.72	137
130	5.67	706	17.2	85.83	585	5.42	146
140	6.14	751	18.5	92.97	622	6.15	156
150	6.62	794	19.7	100.13	660	6.93	165
160	7.10	837	20.9	107.31	697	7.74	175
170	7.58	880	22.2	114.50	734	8.59	184
180	8.06	922	23.4	121.70	770	9.48	193
190	8.55	964	24.6	128.92	806	10.4	202
200	9.03	1005	25.8	136.14	842	11.4	211

Calculated Chronic Freshwater Criteria, ug/L
Based on Dissolved Metal Concentration

Hardness (mg/L)	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
10	0.406	11.2	1.25	0.191	7.41	NA	16.8
20	0.679	19.8	2.26	0.421	13.3	NA	30.2
30	0.918	27.6	3.20	0.664	18.8	NA	42.6
40	1.14	35.0	4.09	0.916	24.0	NA	54.4
50	1.34	42.0	4.95	1.17	28.9	NA	65.7
60	1.53	48.8	5.79	1.44	33.8	NA	76.6
70	1.72	55.3	6.60	1.70	38.5	NA	87.3
80	1.90	61.7	7.40	1.97	43.1	NA	97.8
90	2.07	68.0	8.18	2.24	47.6	NA	108
100	2.24	74.1	8.96	2.52	52.0	NA	118
110	2.40	80.1	9.72	2.79	56.4	NA	128
120	2.56	86.1	10.5	3.07	60.7	NA	138
130	2.72	91.9	11.2	3.34	64.9	NA	148
140	2.87	97.6	11.9	3.62	69.1	NA	157
150	3.02	103	12.7	3.90	73.3	NA	167
160	3.17	109	13.4	4.18	77.4	NA	176
170	3.31	114	14.1	4.46	81.5	NA	185
180	3.45	120	14.8	4.74	85.5	NA	194
190	3.60	125	15.5	5.02	89.5	NA	204
200	3.73	131	16.2	5.31	93.5	NA	213

Ammonia Freshwater Criterion (mg/L)

pH	CMC	CCC
5.5	38.2	3.68
5.6	38.1	3.67
5.7	37.8	3.66
5.8	37.5	3.65
5.9	37.2	3.64
6.0	36.7	3.63
6.1	36.2	3.61
6.2	35.5	3.59
6.3	34.7	3.56
6.4	33.7	3.52
6.5	32.6	3.48
6.6	31.3	3.43
6.7	29.8	3.36
6.8	28.0	3.29
6.9	26.2	3.19
7.0	24.1	3.08
7.1	21.9	2.96
7.2	19.7	2.81
7.3	17.5	2.65
7.4	15.3	2.47
7.5	13.3	2.28
7.6	11.4	2.08
7.7	9.6	1.87
7.8	8.1	1.66
7.9	6.8	1.46
8.0	5.6	1.27
8.1	4.6	1.09
8.2	3.8	0.94
8.3	3.1	0.80
8.4	2.6	0.67
8.5	2.1	0.57

Revised January 2003

APPENDIX J-2

Quality Assurance Project Plan

Quality Assurance Project Plan

Quil Ceda Village Wastewater Treatment Plant Effluent Monitoring Program

Submitted by

The Tulalip Tribes
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July 2002
Project No. 216-1598-012 (07/04)

APPROVAL SHEET

Project Manager, Parametrix

Project Manager, Tulalip Tribes

Project Manager, EPA

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APPENDICES

ACRONYMS

CLP	Contract Laboratory Program
DI	deionized
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
LCS	Laboratory Control Standard
MCL	Maximum Contaminant Level
MS	matrix spike
MSD	matrix spike duplicate
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
PQL	Practical Quantitation Limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOW	Statement of Work
The Tribes	The Tulalip Tribes
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant

1. PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) has been prepared by Parametrix, Inc. under contract to The Tulalip Tribes. The QAPP was prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans* (2001a), and follows guidance provided in *Guidance on Quality Assurance Project Plans* (EPA, 1998).

Monitoring of effluent from the Membrane Wastewater Treatment Plant for Quil Ceda Village is a significant environmental program subject to the requirements of The Tulalip Tribes' *Quality Management Plan.*

1.1 PROJECT ORGANIZATION

The activities described in this QAPP will be conducted by members of The Tulalip Tribes (The Tribes). Specific project quality assurance (QA) responsibilities for The Tribes' Wastewater Treatment Plant Effluent Monitoring Program are described in Table 1-1.

Table 1-1. Quality Assurance Responsibilities for The Tulalip Tribes' Wastewater Treatment Plant Effluent Monitoring Program

Personnel	Responsibilities
(To Be Determined) Project Manager Public Works Director The Tulalip Tribes (Telephone No. to be determined)	Oversee technical team performance to ensure successful accomplishment of the technical and QA project objectives; review QA needs and approve QA corrective action where necessary.
Tommy Gobin Project Coordinator Wastewater Treatment Plant Operator The Tulalip Tribes (Telephone No. to be determined)	Ensure all sampling and handling procedures are followed and documented, and that QA objectives are met; coordinate and participate in the sampling activities; report to the Project QA Officer any discrepancies or deviations from the QAPP; validate data; prepare reports; maintain documentation.
(To Be Determined) Project QA Officer Assistant Public Works Director The Tulalip Tribes (Telephone No. to be determined)	Direct implementation of QAPP, provide technical QA assistance, prepare QA Reports for the Project Manager, evaluate laboratory data, perform QA/QC, and prepare Data Validation Reports.
(To Be Determined) Laboratory QA Officer (Telephone No. to be determined)	Ensure that all laboratory QA objectives are met and data package QA/QC deliverables from the laboratory are correctly documented and reported.

1.2 BACKGROUND

This plan describes quality assurance measures for wastewater treatment plant effluent monitoring. Other quality plans related to this work include:

- Sampling and Analysis Plan (SAP)
- Quality Management Plan

1.3 PROJECT DESCRIPTION

Quil Ceda Village plans to discharge treated wastewater effluent into subsurface infiltration basins located on the Tribal reservation. The Tribes will use membrane technology to treat wastewater prior to infiltration. The discharge must comply with federal Drinking Water Standards. In the future, the discharge may be directed to surface water, if an NPDES Permit is obtained.

The primary objective of the monitoring program described in this QAPP is to monitor the quality of treated effluent from the Tulalip wastewater treatment plant to ensure that concentrations in the effluent do not exceed federal Drinking Water Standards or Surface Water Standards (as applicable depending upon location of the discharge). Existing groundwater monitoring wells are located along the effluent infiltration system. These wells will be used to monitor changes in groundwater levels due to effluent infiltration.

1.4 QUALITY OBJECTIVES AND CRITERIA

1.4.1 Data Quality Objectives

Data quality objectives (DQOs) specify the quality of the data required to meet the stated goals of the project and to ensure collection of representative data of known and documentable quality. All investigation activities should be conducted and documented in accordance with the specified DQOs to ensure that sufficient data of known quality are collected. DQOs for the project have been developed in accordance with the *Guidance for Data Quality Objectives Process* (EPA, 2000).

The first DQO for the project is to obtain appropriate quantitation limits so that the data generated can be compared to applicable standards. These standards are the federal maximum contaminant levels (MCLs) for drinking water. The analytical parameters and quantitation limits are specified in the SAP, and in Section 2.4, Analytical Methods.

A second project DQO is that measurement performance criteria are satisfied for precision, accuracy, representativeness, completeness, and comparability parameters (PARCC). The PARCC parameters are described below. Methods to evaluate whether the data meet the DQOs are described in Section 2.5, Quality Control. Techniques for verifying and validating the data are described in Section 4.

1.4.2 PARCC Parameters

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. It is expressed in terms of the standard deviation or relative percent difference (RPD). Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property), X, with either an accepted reference or true value, T. Accuracy can be expressed as the difference between two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, or as a ratio, X/T. Accuracy includes a combination of random error (precision) and systematic error (bias) components that result from sampling and analytical operations.

Accuracy and precision are determined through quality control parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, quality control (QC) check samples, and duplicates. The project DQOs for the evaluation of these parameters will be project control limits developed and provided by the laboratory based on those given in SW-846 (EPA, 1986), functional guidelines outlined by the EPA for evaluating inorganic or organic analyses (EPA, 1994a, 1994b), or statistical information provided by the laboratory. ***Annually, the Project QA Officer must obtain a list of control limits for accuracy and precision from the laboratory and provide these to the Project Coordinator for use in data validation.***

Representativeness expresses the degree to which sampling data accurately and precisely represent a characteristic of a population. Representativeness will be assessed from review of sampling records and a QA audit of monitoring activities.

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total data collected. The QA objectives for completeness are:

- Data documenting groundwater levels and other operational parameters – 90 Percent.
- Data required to be reported as specified in EPA's approval by rule authorization of the effluent infiltration system or NPDES discharge permit to surface water – 100 Percent.

Comparability expresses the confidence with which one data set can be compared to another (e.g., similar sampling methods, reporting units, etc.). All measurements will be made so that results are comparable with other measurement data for similar samples and sample conditions, and with relevant action levels, criteria, or standards. The samples will be collected and analyzed using standard techniques and reporting analytical results in units consistent with EPA guidelines.

1.5 SPECIAL TRAINING/CERTIFICATION

The Project Coordinator should receive training regarding proper sampling techniques. Health and safety training in accordance with Occupational Safety and Health Administration (OSHA) regulations may be required.

The Project QA Officer should receive training regarding implementation of the QAPP, including techniques for data validation.

1.6 DOCUMENTS AND RECORDS

Project monitoring activities will be documented through the use of daily monitoring logs and other forms as noted in Table 1-2. Examples of the sampling forms are included in Appendix A.

Table 1-2. Sampling and Sample Handling Records

Record	Use	Responsibility/Requirements
Monitoring notebook	Record significant events and observations.	Maintained by sampler; must be bound; all entries must be factual, detailed, objective; entries must be signed and dated.
Sampling Data Sheet	Provide a record of each sample collected (see Appendix A).	Completed, dated, and signed by sampler; maintained in project file.
Sample Label	Accompanies sample; contains specific sample identification information.	Completed and attached to sample container by sampler.
Chain-of-Custody Form	Documents chain of custody for sample handing (see Appendix A).	Documented by sample number. Original accompanies sample. A copy is retained by QA Officer.
Chain-of-Custody Seal	Seals the sample shipment container (i.e., cooler) to prevent tampering or sample transference (see Appendix A). Individual samples do not require custody seals, unless they are to be archived, before going to the lab for possible analysis at a later date.	Completed, signed, and applied by sampler at time samples are transported.
Sampling and Analysis Request	Provides a record of each sample number, date of collection/transport, sample matrix, analytical parameters for which samples are to be analyzed (see Appendix A).	Completed by sampler at time of sampling/transport; copies distributed to laboratory project file.

1.6.1 Monitoring Records

1.6.1.1 Monitoring Logs

A bound monitoring notebook will be maintained to provide daily records of significant events and observations that occur during monitoring activities. All entries are to be made in waterproof ink, signed, and dated. Corrections will be made according to the procedures given at the end of this section.

Monitoring notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the samplers if called upon to give testimony during legal proceedings. The monitoring notebook entries should be factual, detailed, and objective. All monitoring logs and forms will be retained by the Project Coordinator and secured in a safe place.

Pages of the monitoring notebook are not to be removed, destroyed, or thrown away. Corrections will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.

If an error made on a document is assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry.

1.6.1.2 Photographs

All photographs taken of monitoring activities will be documented with the following information noted on a photo log:

- Date, time, and subject or location of photograph taken.
- Photographer.
- Weather conditions.
- Description of photograph taken.
- Reasons photograph was taken.
- Sequential number of the photograph and the film roll number.
- Viewing direction.

The photographer will review the photographs or slides when they return from developing and compare them to the log, to assure that the log and the photographs match.

1.6.2 Laboratory Records

All laboratory data packages will contain the following information:

- Cover letter.
- Chain-of-Custody forms.
- Summary of sample results.
- Summary of QC results.

The information provided in the cover letter will include:

- Laboratory name, address, and telephone number.
- Date(s) of sample receipt and number of samples received.
- Detailed description of any problems encountered with QC, analysis, shipment, or handling procedures.
- Identification of possible reasons for any QC criteria outside acceptance limits.
- Signature of laboratory representative and date certifying data results.

Following is the minimum information to be presented for each sample for each parameter or parameters group:

- Client sample number and laboratory sample number.
- Sample matrix.
- Date of extraction/preparation and date/time of analysis.
- Dilution factors.
- Sample weights/volumes used in sample preparation/analysis.
- Identification of analytical instrument.
- Analytical method.
- Detection/quantitation limits.
- Definitions of any data qualifiers used.

The minimum QC summary information to be presented for each sample for each parameters or parameter group will include:

- Surrogate standard recovery results.
- Matrix QC results (matrix spike/matrix spike duplicate, duplicate).
- Method blank results.
- Laboratory check standard results.

2. DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The wastewater effluent samples will be collected at a location representing the quality of effluent that will be discharged to the infiltration area. A schedule for data collection has been developed to ensure that sufficient samples are available during the early stages of the project to ensure representativeness and completeness, and is included in the SAP.

2.2 SAMPLING METHODS

Procedures for sample collection are presented in the SAP. Wastewater effluent samples will be collected directly into prelabeled sampling containers provided by the analytical laboratory. Therefore, no decontamination of equipment or sampling containers will be required. Each sample will be labeled, chemically preserved (if required), and sealed immediately after collection. The labels will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with waterproof tape. An example sample label is provided in Appendix A.

The following information will be given on each sample label:

- Project name and number.
- Name of sampler.
- Date and time of sample collection.
- Sample station.
- Sample number.
- Analysis required.
- Preservation.

A summary of specifications for containers, holding times, preservation, and handling for each matrix and analysis group is shown in Table 2-1.

Table 2-1. Sample Containers, Preservatives, and Holding Times

Analyses	Sample	Container Size (ml)	Preservation and Handling	Holding Times[a, b, c]	Sampling Method
Nitrate, nitrite	HDPE[d]	500	Cool to 4°C	48 hours	24-Hour Composite
Ammonia, TKN	HDPE	500	H_2SO_4	28 days	24-Hour Composite
Fecal coliform, total coliform, *E. coli*	Corning	4 oz	NaOH	24 hours	24-Hour Composite

(Table Continues)

Table 2-1. Sample Containers, Preservatives, and Holding Times (Continued)

Analyses	Sample	Container Size (ml)	Preservation and Handling	Holding Times[a, b, c]	Sampling Method
Total suspended solids	HDPE	1,000	Cool to 4°C	7 days	24-Hour Composite
Cyanide	HDPE	500	NaOH	14 days	24-Hour Composite
Metals (except mercury) hardness, alkalinity	HDPE	1,000	HNO_3 to pH <2	6 months	24-Hour Composite
Mercury	HDPE	500	HNO_3 to pH <2	28 days	24-Hour Composite
Volatile organics	Glass vial; Teflon-lined-silicon septum cap	40 x 2	Fill bottles leaving no air space; keep in dark, cool to 4°C; HCL to pH <2	7 days; 14 days if preserved	Grab
Pesticides	Amber glass with Teflon-lined lid	1,000	Cool to 4°C	7 days until extraction; 40 days after extraction until analysis	24-Hour Composite
PCBs	Amber glass with Teflon-lined lid	1,000	Cool to 4°C	7 days until extraction; 40 days after extraction until analysis	24-Hour Composite
Total petroleum hydrocarbons	Glass	1,000	Cool to 4°C	7 days	24-Hour Composite

[a] EPA 1983. *Methods for Chemical Analysis of Water and Wastes.*

[b] EPA 1986. *Test Methods for Evaluating Solid Waste (SW-846)*, 3rd Edition.

[c] APHA – AWWA – WPCF 1989. *Standard Methods for the Examination of Waste and Wastewater*, 17th Edition.

[d] HDPE = High-density polyethylene.

2.3 SAMPLE HANDLING AND CUSTODY

This section describes standard operating procedures for sample custody and the chain-of-custody procedures to be used for this project. These procedures ensure that the quality and integrity of the samples are maintained during collection, transportation, storage, and analysis of the samples.

2.3.1 Sample Custody

The chain-of-custody procedures used for this project provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until the completion of all required analyses. A sample is in custody if it is in any of the following places:

- In physical possession of an authorized person.
- In view of an authorized person.

- In a secured container.
- In a designated secure area.

2.3.1.1 Chain-of-Custody Form

The following information will be provided on the Chain-of-Custody Form:

- Sample identification numbers.
- Matrix type for each sample.
- Analytical methods to be performed for each sample.
- Number of containers for each sample.
- Sampling date and time for each sample.
- Names of all sampling personnel.
- Signature and dates indicating the transfer of sample custody.

An example Chain-of-Custody Form is presented in Appendix A.

2.3.1.2 Sample Custody Procedures

As few people as possible will handle the samples, and the sample custody procedures below will be followed:

- Coolers or boxes containing clean sample bottles will be sealed with a chain-of-custody tape seal (see example in Appendix A) during transport to the wastewater treatment plant (WWTP) or while in storage before use.
- The Project Coordinator or designee will be responsible for the care and custody of the samples collected until the samples are transferred or dispatched properly.
- The Project Coordinator or designee will record sample data on the Sampling Data Sheet (see example in Appendix A).
- The Project Coordinator will determine whether proper custody procedures were followed during the work and will decide if additional samples are required.

2.3.1.3 Laboratory Custody Procedures

The laboratory sample custodian will inspect the samples, sign the Chain-of-Custody Forms, and log the samples into the laboratory data management system. Sample inspection upon receipt will include the following steps to check that samples have been collected and handled according to appropriate protocols:

- Inspect the shipment for broken or leaking containers or inappropriate sample containers or caps.
- Check bottle labels against Chain-of-Custody Forms for discrepancies.

- Check holding times.
- Check for air bubbles in sample bottles for volatile organic analyses (VOAs).
- Check pH on all preserved sample bottles and add preservatives as needed to meet preservation requirements.
- Document any problems on the Chain-of-Custody Form and contact originator.

After samples have been inspected, they will be logged into the laboratory information management system. Each sample will be assigned a unique specific identification number. Additional data is then input regarding each sample, including the date and time of receipt, client identification, and analytical parameters. Each container is labeled with its identification number.

2.3.2 Transfer of Custody and Shipment

The samples will be transported and handled in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of the samples. Samples will be personally delivered by a Tulalip Tribes employee, or shipped via courier or overnight delivery service to the analytical laboratory within 24 hours of sample collection.

Sample documents will be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents will include:

- Monitoring notebooks.
- Sample data sheet.
- Sample labels.
- Chain-of-custody records.

Examples of the Sample Data Sheet, the Sample Container Label, the Chain-of-Custody Form, and Chain-of-Custody Seal are included in Appendix A.

When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Form and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Project documentation of sample custody will be verified by the Project QA Officer during regular review of the data validation package.

The following transfer of custody and shipment procedures will be followed:

- Each cooler in which samples are packed must be accompanied by a Chain-of-Custody Form. When transferring samples, the individuals relinquishing and receiving the samples must sign, date, and note the time on the Chain-of-Custody Form to document sample custody transfer.

- Shipping containers will be sealed with Chain-of-Custody Seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the Chain-of-Custody Form.

- All shipments will be accompanied by the Chain-of-Custody Form to identify the contents. The original form will accompany the shipment. The other copies will be distributed as appropriate to the Project QA Officer and Project Manager.

- If sent by mail, the package will be registered with "Return Receipt Requested." If sent by common carrier, a bill of lading will be used. Freight bills, postal services receipts, and bills of lading will be retained as part of the permanent documentation.

2.4 ANALYTICAL METHODS

Analytical methods and reporting limits for the planned analyses are provided in Table 2-2 (page 2-6). The reporting limit in most cases is equal to the Practical Quantitation Limit (PQL), or the concentration that can be reliably measured within specified limits during routine laboratory operating conditions using approved methods. Where appropriate, these procedures may be modified, based on anticipated data uses and with recognition of validation requirements, to incorporate techniques familiar to the project laboratory. The laboratory will notify the Project QA Officer of any proposed procedural changes and document these changes in the cover letter with the data reports.

Matrix interferences may make achievement of the desired detection limits and associated quality control criteria impossible. In such instances, the laboratory must report to the Project QA Officer the reason for noncompliance with quality control criteria or elevated detection limits.

2.5 QUALITY CONTROL

Quality control checks consist of measurements performed in the WWTP and laboratory. The analytical methods referenced in Section 2.4 specify routine methods required to evaluate data precision and accuracy, and determine whether the data are within the quality control limits. Guidelines for minimum samples for QA/QC sampling and laboratory analysis are summarized in Table 2-3.

Table 2-3. Guidelines for Minimum QA/QC Samples for Sampling and Laboratory Analysis

	WWTP		Laboratory					
Media	Duplicate	Transfer Blank (if necessary)	Trip Blank[a]	Matrix Duplicate[b]	Matrix Spike	Matrix Spike Duplicate[c]	Method Blank	LCS[d]
Aqueous	1 in 20,[e] or annually	1 in 20	1 per cooler	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch	1 in 20, or per batch

[a] Trip blank analyzed for volatile organic compounds only.

[b] Matrix duplicate analyzed for metals.

[c] Matrix spike duplicate analyzed for organic analyses.

[d] Laboratory Control Sample.

[e] All frequencies of 1 in 20 indicate 1 per batch, when the batch is less than 20 samples.

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Instrument Parameters							
Dissolved oxygen	mg/L	NA	8.0	NA	360.2	0.1	High dissolved oxygen required for discharge to SW or fish rearing ponds.
pH	standard units	NA	6.5–9	NA	150.1	0.05	
Specific conductance	(μs/cm)	700	NA	NA	120.1	1.0	
Turbidity	NTU	NA	NA	NA	180.1	0.01	
Inorganic Compounds							
Metals[a]		Total Metal[c]	Dissolved Metal[c]	Total Metal[c]			
Antimony	mg/L	0.006	NA	4.3	200.8/200.7[d]	0.005	
Arsenic	mg/L	0.01 (total Cr)	0.34 (0.15)	0.14	200.8/200.7	0.001	SW standard applicable to both total and dissolved arsenic.
Barium	mg/L	2	NA	NA	200.8/200.7	0.005	
Beryllium	mg/L	0.004	NA	See footnote[e]	200.8/200.7	0.001	
Cadmium	mg/L	0.005	0.0043 (0.0022)	See footnote[e]	200.8/200.7	0.001	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Chromium (III)	mg/L	0.1 (total Cr)	0.57 (0.074)	See footnote[e]	200.8/200.7	0.005	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Copper	mg/L	1.3	0.013 (0.009)	NA	200.8/200.7	0.005	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Lead	mg/L	0.015	0.065 (0.0025)	See footnote[e]	200.8/200.7	0.001	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Mercury	mg/L	0.002	0.0014 (0.00077)	0.000051[e]	245.1	0.0001[f]	
Nickel	mg/L	0.1	0.47 (0.052)	4.6[e]	200.8/200.7	0.01	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Selenium	mg/L	0.05	See Comment (0.005)	11[e]	200.8/200.7	0.005	CMC = 1/[(f1/CMC1)+(f2/CMC2)] Where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, and CMC1 and CMC2 are 0.1859 and 0.01283 mg/L, respectively. For this project, criteria will be compared to total selenium x 0.922 as allowed by the standards, unless required otherwise due to elevated concentrations of total selenium.

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Silver	mg/L	0.002	3.4 (None)	NA	200.8/200.7	0.002	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
Thallium	mg/L	0.002	NA	0.0063[e]	200.8/200.7	0.002	
Zinc	mg/L	5	0.120 (0.120)	69[e]	200.7 or equivalent	0.006	SW standard is hardness dependent. Value shown is for hardness of 100 mg/L. Calculate actual standard per Appendix B.
<u>Conventional Parameters</u>							
Alkalinity	mg/L	NA	>20	NA	310.1	1.0	
Ammonia (as N)	mg/L	NA	See Comment	NA	350.1	0.01	SW standard is pH dependent. See Appendix B.
BOD5	mg/L	NA	NA[e]	NA	405.1	1.0	
Cyanide	mg/L	0.2	0.022 (0.0052)	220	335.2/335.4	0.005	As free cyanide.
Hardness	mg/L	NA	NA	NA	200.7	0.5	
Nitrate	mg/L	10 (as N)	NA	NA	300.0	0.01	
Nitrite	mg/L	1 (as N)	NA	NA	300.0	0.01	
Phosphorus	mg/L	NA	NA[e]	NA	365.2	0.008	
TKN	mg/L	NA	NA	NA	351.2	0.1	
Total Suspended Solids	mg/L	NA	NA	NA	160.2	1.0	

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Microbiological Tests							
Fecal coliform	MPN/100 mL	0	NA	NA	9221B	1	
E. coli	MPN/100 mL	0	100[g]	14[h]	9221F	1	
Total coliforms	MPN/100 mL	0	NA	NA	9221E	1	
Organic Compounds							
Benzene	mg/L	0.005	NA	0.071	524.2	0.00025	
Carbon tetrachloride	mg/L	0.005	NA	0.0044	524.2	0.00025	
Chlorobenzene	mg/L	0.1	NA	21	524.2	0.00025	
Dibromochloro-3-propane	mg/L	0.0002	NA	NA	504.1	0.0002	
Dichlorobenzene, 1,2-	mg/L	0.6	NA	NA	524.2	0.00025	
Dichlorobenzene, 1,4-	mg/L	0.075	NA	NA	524.2	0.00025	
Dichloroethane, 1,2-	mg/L	0.005	NA	0.099	524.2	0.00025	
Dichloroethene, 1, 1-	mg/L	0.075	NA	0.0032	524.2	0.00025	
Dichloroethene, cis-1,2-	mg/L	0.005	NA	NA	524.2	0.00025	
Dichloropropane, 1,2-	mg/L	0.005	NA	NA	524.2	0.00025	
Dichloromethane	mg/L	0.005	NA	NA	524.2	0.00025	
Dichloroethene, trans-1,2-	mg/L	0.1	NA	NA	524.2	0.00025	
Ethyl benzene	mg/L	0.7	NA	29.0	524.2	0.00025	
Ethylene dibromide (EDB)	mg/L	1.0	NA	NA	524.2	0.00025	
Hexachlorobenzene	mg/L	0.001	NA	NA	524.2	0.00025	
Styrene	mg/L	0.1	NA	NA	524.2	0.00025	
Tetrachloroethene	mg/L	0.005	NA	0.00885	524.2	0.00025	
Toluene	mg/L	1.0	NA	200	524.2	0.00025	

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
1,2,4-trichlorobenzene	mg/L	0.07	NA	NA	524.2	0.00025	
1,1,1-trichloroethane	mg/L	0.2	NA	See footnote[e]	524.2	0.00025	
1,1,2-trichloroethane	mg/L	0.005	NA	0.042	524.2	0.00025	
Trichloroethene	mg/L	0.005	NA	0.081	524.2	0.00025	
Vinyl chloride	mg/L	0.002	NA	0.525	524.2	0.00025	
Xylenes	mg/L	10	NA	NA	524.2	0.00025	
Pesticides							
Chlordane	mg/L	0.002	0.0000043	0.0000022	508A	0.00005[f]	Reporting limits of 0.0000025 are theoretically achievable for each of these compounds under ideal conditions.
Heptachlor	mg/L	0.0004	0.0000038	0.00000021	508A	0.00005[f]	
Heptachlor epoxide	mg/L	0.0002	0.0000038	0.00000011	508A	0.00005[f]	
Lindane	mg/L	0.0002	0.000095	0.000063	508A	0.00005	
Methoxychlor	mg/L	0.04	NA	NA	508A	0.00005	
PCBs							
Aroclor 1016	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	Reporting limit of 0.000017 is theoretically achievable for all aroclors under ideal conditions.
Aroclor 1221	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1232	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1242	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1248	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1253	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Aroclor 1260	mg/L	0.0005	0.000014	NA	508A	0.000122[f]	
Total PCBs	mg/L	NA	NA	0.000017	NA	NA	Calculate as sum of detected aroclors[f].

(Table Continues)

Table 2-2. Target Compounds, Standards, Analytical Methods, and Reporting Limit Requirements (Continued)

Item	Units	MCL	Freshwater Maximum (Continuous) Surface Water Concentrations[b]	Human Health Criteria for Consumption of Aquatic Organisms	Analytical Method	Reporting Limit	Comment
Total TPH							
NW-TPH-G	mg/L	MTCA	NA	NA	WDOE Method	1.0	
NW-TPHD extended	mg/L	MTCA			WDOE Method	1.0	

Note: NA = Not applicable, MTCA = Model Toxics Control Act, WDOE = Washington State Department of Ecology

[a] Metals concentrations will be tested as total recoverable metals unless concentrations exceed an applicable surface water criteria, in which case dissolved concentrations will be analyzed.

[b] Per National Recommended Water Quality Criteria – Correction, EPA822-Z-99-001, April 1999. Valve shown is acute concentration. Valve shown in parentheses is chronic concentration.

[c] MCLs are applied as total metals, surface water standards are applied as dissolved metals.

[d] Use 200.7 when the analyte is detected 5x higher than the Method Detection Limit.

[e] Development of a site-specific discharge limit may be necessary if effluent is used for fish rearing.

[f] Lowest practical reporting limit.

[g] Proposed criterion.

[h] Applicable to shellfish only.

2.5.1 WWTP Methods

The following quality control samples will be evaluated to verify accuracy and precision of laboratory results for this project. The frequency of quality control sample evaluation may be adjusted when the final sampling schedule is determined. The frequencies of quality control sample evaluation described here should be considered a minimum.

2.5.1.1 Trip Blank

A minimum of one trip blank will be analyzed each sampling event for volatile organic compounds (VOCs). There should be one trip blank in each cooler used to ship VOC samples to the laboratory. The trip blank will consist of a purged-free deionized (DI)/distilled water blank supplied by the analytical laboratory. It will be transported to and from the WWTP, then returned to the laboratory unopened and unaltered for analysis. The term "purged-free" water refers to DI/ distilled water that has been boiled and capped in the laboratory. Transfer blanks will be analyzed if contaminants are found in the trip blank to determine if contamination is due to possible container contamination.

2.5.1.2 Transfer Blank

Transfer blanks will be collected and analyzed if the source of trip blank contamination cannot be discovered. The transfer blank will consist of DI/distilled water (supplied by the analytical laboratory) transferred in the WWTP into the appropriate sampling containers. The transfer blank will evaluate possible sample contamination from the sampling event.

2.5.1.3 Duplicate

A minimum of one blind duplicate will be analyzed per 20 samples, or one annually (whichever is greater), to verify the precision of laboratory and/or sampling methodology. The duplicates for samples will be collected sequentially. The samples will be coded so the laboratory cannot discern which samples are duplicates.

2.5.2 Laboratory Methods

Specific procedures and frequencies for laboratory quality control are detailed by analytical method in the laboratory QA Plan. A general description of the types of required laboratory QC samples is provided below.

2.5.2.1 Method Blank

A minimum of one laboratory method blank will be analyzed per 20 samples or one per batch (whichever is greater), to assess possible laboratory contamination. Method blanks will contain all reagents and undergo all procedural steps used for analysis.

2.5.2.2 Control Sample

A minimum of one laboratory control standard (LCS) per 20 samples or one per sampling event (whichever is greater) will be analyzed for inorganics to verify precision of laboratory equipment. The LCS will be a concentration within the calibration range at a different concentration than the standards used to establish the calibration curve. LCS analysis will follow EPA LCS guidelines established in SW-846 (EPA, 1986).

2.5.2.3 *Matrix Spike*

A minimum of one laboratory matrix spike (MS) per 20 samples will be analyzed for VOCs, or one per sampling event (whichever is greater), to monitor recoveries and assure that extraction and concentration levels are acceptable for QA/QC review. The laboratory matrix spike will follow the matrix spike guidelines specified in the Contract Laboratory Program (CLP) Statements of Work (SOWs) (EPA, 1993a, 1993b).

2.5.2.4 *Matrix Spike Duplicate*

A minimum of one laboratory matrix spike duplicate (MSD) per 20 samples will be analyzed for VOCs, or one per sampling event (whichever is greater), to provide information on the precision of chemical analysis. MSDs (rather than matrix duplicates) apply to organic analyses because of the large number of undetected compounds. Comparing the MS and MSD provides better information on the quality of the data. The laboratory matrix spike duplicate will follow EPA matrix spike duplicate guidelines specified in SW-846 (EPA, 1986).

2.5.2.5 *Matrix Duplicate*

A minimum of one laboratory matrix duplicate will be analyzed per 20 samples, or one per sampling batch (whichever is greater), when samples are analyzed for metals and conventionals, to provide information on the precision of chemical analysis. The laboratory duplicate will follow EPA duplicate guidelines specified in the SW-846 (EPA, 1986).

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

2.6.1 Monitoring Instruments

The Project Coordinator will arrange for instrumentation preventive maintenance. Preventive maintenance on monitoring instruments will be performed by qualified technicians following the manufacturer's instructions and maintenance schedules. Maintenance will be documented in instrument logbooks with the date and initials of the individual performing the maintenance.

The Project Coordinator will routinely review and compare instrument calibration results against the preventive maintenance records to verify the effectiveness of the preventive maintenance program. The Project Coordinator will track scheduling of preventive maintenance required by the manufacturer.

2.6.2 Laboratory Instruments

The analytical laboratory manager is ultimately responsible for the care of the laboratory instruments. He or she may delegate the responsibility to the senior supervising chemists or technicians qualified to perform routine maintenance, after demonstrating that personnel are trained in maintenance procedures for that laboratory section (wet chemistry, metals, and organics). Training of laboratory personnel on the routine care of laboratory equipment will be provided, at a minimum, during the initial installation of the equipment and, for new analysts, before initial use of the equipment.

Maintenance and other appropriate details will be documented in daily maintenance logbooks. The individual performing the maintenance procedures will date and sign each entry. At a minimum, the preventive maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

2.7 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

2.7.1 Monitoring Instruments

Monitoring instruments will be calibrated according to manufacturer's instructions. All instruments to be used will be calibrated on a daily basis, when used. The following data will be recorded on appropriate forms:

- Date.
- Project number.
- Instrument make and model number.
- Instrument response during calibration.

2.7.2 Laboratory Instruments

All instruments and equipment used during analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, and in accordance with procedures in the analytical method cited, as documented in the laboratory QA Plan. Properly trained personnel will operate, calibrate, and maintain laboratory instruments. Calibration blanks and check standards will be analyzed daily for each parameter to verify instrument performance and calibration before beginning sample analysis.

Where applicable, all calibration procedures will meet or exceed EPA CLP protocols (EPA, 1993a, 1993b). Any variations from these procedures must be approved by the Project QA Officer before beginning sample analysis.

After the instruments are calibrated and standardized within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. Acceptable performance of the QC check sample verifies the instrument performance on a daily basis. Analysis of a QC check standard is also required. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check samples will be analyzed and evaluated according to the EPA method criteria.

Instrument performance check standards and calibration blank results will be recorded in a laboratory instrument logbook that will also contain evaluation parameters, benchmark criteria, and maintenance information. If the instrument logbook does not provide maintenance information, a separate maintenance logbook will be maintained for the instrument.

2.8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Consumables for this project include laboratory-supplied sampling containers, deionized water used for blanks, and calibration standards for monitoring instruments. The Project Coordinator will be responsible for accepting, inspecting, and tracking consumables using appropriate developed forms. Records for calibration standards should include, at a minimum, source of procurement, concentration, and expiration date.

2.9 NON-DIRECT MEASUREMENTS

Non-measurement sources such as computer databases, programs, literature files, and historical databases are not expected to be required in this project.

2.10 DATA MANAGEMENT

This section contains a description of data management procedures, including sample identification, data handling, and data storage. The objectives of the data management plan are to assure that large volumes of information and data are technically complete, accessible, and efficiently handled.

2.10.1 Laboratory Data

Data (including instrument calibrations, chromatograms, and mass spectra), procedural logs for each instrument, sample extraction and preparation logs, and standard preparation logs will be kept on file at the laboratory.

Sample and QC results will be stored in a database maintained by the analytical laboratory. Data will be provided by the laboratory in electronic format for direct input into the project database.

2.10.2 Wastewater Treatment Plant Data

Techniques to assign sample identification numbers and to manage and analyze analytical data generated by the laboratories are described below. Prior to the sampling event, each sample location will be assigned a unique code. Each sample collected at that location will be preassigned an identification code using the sample location followed by other specific information describing the sample. The following example illustrates the sample identification system:

EF-122002-001-0

Where:

EF	=	Effluent
122002	=	Date
001	=	Station number
0	=	Code indicating whether the sample is a duplicate, where 0 is assigned for the sample, and 1 is assigned for a duplicate sample

Where appropriate, sample labels and forms will be preprinted with the appropriate sample identification code.

2.10.3 Office Data

2.10.3.1 Hard Copy Data

The original hard (paper) copies of all notes and laboratory reports will be stored in the project file in standard metal file cabinets. Photocopies of these documents should be prepared for working copies as needed.

Data should be recorded in bound notebooks or individual sampling sheets. The sampler should review the data for completeness prior to placing it in the files.

2.10.3.2 Electronic Data

All data will be stored in the project database. Instrument data (pH, specific conductivity, dissolved oxygen, turbidity) will be added from the monitoring notebook or Sampling Data Sheets by direct data entry, or will be handled electronically. Laboratory analytical results will be added by direct transfer from the laboratory on computer disk.

The project database will contain a minimum of three files: Results, Sample, and Chemical. A list of fields that each of these files will contain is presented in Attachment A. The Results file will store data related to the analytical test results, including the value, units, data qualifiers, analytical method, and date analyzed. The Sample file will relate the sample identification number to the sampling location, date, and time sampled. The Chemical file will contain information about each of the chemicals tested, including the chemical name, Chemical Abstract Service (CAS) number, and applicable regulatory criteria.

The specific steps involved in the electronic data management process are outlined below.

1. Obtain analytical data results from the testing laboratory in electronic format on computer disk.
2. Conduct QA/QC data validation of analytical data according to procedures described in the project QAPP.
3. Inspect electronic data for accuracy and completeness.
4. Add additional data qualifier codes, if required, to electronic data file.
5. Enter data into data file; check data entry 100 percent against data sheets or monitoring notebook.
6. Create Sample file and enter information from monitoring notebook or Sampling Data Sheets (e.g., sampling date, time, etc.).
7. Append Results file and Sample file to project database.
8. Generate data summary tables; check 10 percent against hard copy.
9. Output data for required analyses such as statistical evaluation.

The database will be stored in a central network location that will be accessible via password to authorized project personnel. The database will be backed up on a weekly basis.

To export data for use with other software tools, data will be extracted from the project database by making queries. The file will then be exported into a neutral format (e.g., delimited ASCII) or to a format specific to the analysis package. Examples of data analysis tools that may be used for the project include graphical representations (e.g., GIS), statistical analysis (e.g., SAS), and contouring (e.g., Surfer for Windows).

2.11 REPORTS TO MANAGEMENT

Quarterly, the Project Coordinator must prepare a quality report for the Project Manager describing adherence to the requirements of the SAP and QAPP, results of data validation, significant problems identified, corrective actions taken, and recommendations for improvements. The report should also be provided to the Project QA Officer.

3. ASSESSMENT AND OVERSIGHT

3.1 ASSESSMENTS AND RESPONSE ACTIONS

3.1.1 Audits

Performance and system audits will be performed at least annually by the Project QA Officer. Audits will consist of direct observation of work being performed and inspection of WWTP and laboratory equipment. The performance and system audits will also review the sample custody procedures in the WWTP and laboratory.

If implemented, internal audits of both the WWTP and laboratory activities will be conducted by the Project QA Officer. Audits will be unannounced to assure a true representation of the technical and QA procedures employed.

Checklists for both WWTP and laboratory audits will be based on National Enforcement Investigation Center (EPA, 1984) audit checklists. The audits will be performed by persons having no direct responsibilities for the activities being performed.

Before the internal audit, the auditor(s) will meet with the audited party and define the scope of the audit. The actual audit will consist of reviewing audited activities, completing the checklist, noting any nonconformances or deficiencies, and other relevant observations. An exit interview will be conducted with the audited party to notify them of preliminary audit findings.

The auditor or designee will prepare an audit report that includes findings, nonconformances, observations, and recommended corrective action with a schedule for completion of such action. The audit report format is shown in Table 3-1.

Table 3-1. Audit Report Format

Item	Description
1.	Purpose of Audit
2.	Audit Basis
3.	Time and Place of Audit
4.	Personnel Contacted
5.	Audit Team Members
6.	Summary of Events
7.	Findings and Recommendations
	a. Positive Findings
	b. Negative Findings
8.	Required Follow-up (responsible parties, summary of required corrective action, date of re-audit, if required)
9.	Distribution of Audit Report and Corrective Action Reports

3.1.2 Corrective Action

For each identified nonconformance, a corrective action report will be issued as part of the audit report to notify the individual responsible for implementing the recommended corrective action and its schedule for completion. If a corrective action is required, the Project Manager will be notified. If a laboratory corrective action is required, the Laboratory QA Officer will be notified. The audit will be distributed to the Project Manager.

The audit will remain open until all corrective action is completed by the responsible party and approved by the Project QA Officer. Once all findings are corrected and documented on Corrective Action Reports, the audit is closed by the Project QA Officer. An audit may be closed either by a memo filed with the audit report or by other appropriate methods.

Corrective actions may be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in the SAP or QAPP.
- Equipment or analytical malfunctions.

During WWTP operations and sampling procedures, the Project Coordinator will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the monitoring notebook. If conditions are such that conformance with the SAP or QAPP is not possible, the Project QA Officer will be consulted immediately. Any corrective action or condition resulting in a major revision of the QAPP will be communicated to the Project Manager for review and concurrence. Whenever possible, this communication will be made before changes in monitoring procedures are implemented.

During laboratory analysis, the Laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in the QAPP, corrective action will follow the guidelines in SW-846 (EPA, 1986). This includes, at a minimum, the following considerations:

- Calibration check compounds must be within performance criteria specified in SW-846 (EPA, 1986) or corrective action must be taken before sample analysis begins.
- Before processing any samples, the analyst will demonstrate by analysis of a reagent blank that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank will be processed as a safeguard against chronic laboratory contamination. The blank samples will be carried through all stages of the sample preparation and measurement steps.
- Surrogate spike analysis must be within the contract required recovery limits or corrective action must be taken and documented.

If analytical conditions do not conform with this QAPP, the Project QA Officer will be notified as soon as possible so that additional corrective actions can be taken.

Corrective Action Reports will document response to any reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities.

Corrective Action Reports will be review for appropriateness of recommendations and actions by the Project QA Officer for QA matters, and the Project Manager for matters of technical approach.

3.2 REPORTS TO MANAGEMENT

The Project QA Officer will be responsible for data quality assessments and associated QA reports. A Data Validation Report will be prepared by the Project QA Officer (see Section 4.3) and will accompany all data packages. This report will summarize all relevant data quality information and will discuss the usability of the data. Final task or investigative reports will contain a separate QA section summarizing data quality information.

4. DATA VALIDATION AND USABILITY

Verification is confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation is also confirmation by examination and provision of objective evidence that the particular requirement for a specific intended use have been fulfilled. Techniques for data verification and validation will be in accordance with the *Guidance on Environmental Data Validation and Verification* (EPA, 2001b).

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Analytical data will be reviewed by the Laboratory QA Officer to assure that the QA/QC objectives for precision, accuracy, representativeness, completeness, and comparability have been met. These reviews will identify the occurrence of deficiencies in time to take corrective action. If the required QC objectives are not met after the corrective action is performed, the Project QA Officer will be notified by the Laboratory QA Officer before data submittal. The Project QA Officer will determine if additional corrective action should be taken, such as re-analysis, if applicable.

The project control limits for acceptable precision and accuracy will be those developed by the selected laboratory based on established SW-846 (EPA, 1986). All data packages provided by the laboratory must include a summary of quality control results adequate to enable reviewers to validate or determine the quality of the data.

The Project QA Officer is responsible for conducting checks for internal consistency, transmittal errors, and for adherence to the quality control elements specified in Section 2.5 of the QAPP. The Project QA Manager will review the data package submitted by the laboratory to ensure that documentation has been provided (as described in Section 1.6.2), appropriate QC checks have been performed, and that appropriate corrective actions have been taken. Data will be qualified using guidance provided in the CLP functional guidelines for assessing data (EPA, 1994a, b). The Project QA Manager will then determine the potential effects of any deviations or corrective actions on the suitability of the data.

Duplicate samples will be analyzed as QC samples for verification of precision and accuracy. If the results of the duplicates are outside the control limits, corrective action and/or data qualification will be determined after review by the Project QA Officer. Results of duplicate sample can be of poor quality because of sample heterogeneity. Therefore, corrective action will be determined by the Project QA Officer and discussed in the Data Validation Report.

Instrument measurements (pH, specific conductance, and temperature) will be verified and checked through review of instrument calibration, measurement, and recording procedures.

4.2 VERIFICATION AND VALIDATION METHODS

This section describes routine procedures for assessing project data. The Project QA Officer will review the following quality control data results for all samples:

- Chain-of-custody documentation.
- Holding times.

- Trip blanks.
- Rinsate blanks.
- Transfer blanks.
- Duplicates.
- Method blanks.

A limited review (minimum 10 percent) of the following quality control data results will be conducted:

- Laboratory matrix spike/matrix spike duplicate and/or matrix duplicate results.
- Laboratory surrogate recoveries.
- Laboratory check samples.

If, based on this limited review, the quality control data results indicate potential data quality problems, further evaluations will be conducted.

4.2.1 Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that measure precision include duplicates, matrix spike duplicates, and matrix duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), which is calculated:

$$\text{RPD} = \frac{D_1 - D_2}{(D_1 + D_2) \div 2} \times 100$$

Where:

D_1 = First sample value

D_2 = Second sample value

The RPDs will be routinely calculated and compared with DQOs. Control limits are established by determining the standard deviation of a series of replicate measurements.

4.2.2 Accuracy

Accuracy is assessed using the results of standard reference material, linear check samples, and matrix spike analyses. It is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against DQOs.

4.2.3 Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with the data quality objectives.

4.2.4 Representativeness

Sample locations and sampling procedures will be chosen to maximize representativeness. A qualitative assessment (based on professional experience and judgment) will be made of sample data representativeness based on review of sampling records and QA audit of monitoring activities.

4.3 RECONCILIATION AND USER REQUIREMENTS

The Project QA Officer will prepare a Data Validation Report for each data package describing the results of the data validation and describing any qualifiers that were added to the data. The memorandum will include recommendations on whether additional actions such as resampling are necessary. The Data Validation Report will be submitted to the Project Manager and EPA Project Manager.

5. REFERENCES

APHA-AWWA-WPCF (American Public Health Association–American Water Works Association-Water Pollution Control Federation). 1989. *Standard methods for the examination of waste and wastewater*, 17th edition.

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APPENDIX A

Sampling Forms

Chain of Custody Record & Laboratory Analysis Request

Date: ______
Page ______ of ______
Number of coolers: ______
Cooler Temp: ______

Analytical Resources, Incorporated
Analytical Chemist and Consultants
400 Ninth Avenue North
Seattle, WA 98109-4708
(206) 621-6490
(206) 621-7523 (Fax)

ARI Client: Phone#:

Client Contact:

Client Project ID:

Samplers:

	Sample ID	Date	Time	Matx	No Cont	Lab ID	Analysis Required								Notes/Comments
1															
2															
3															
4															
5															
6															
7															

ARI Project No:	Relinquished by: (Signature)	Relinquished by: (Signature)	Relinquished by: (Signature)
T.A.T. Requested:	Printed Name:	Printed Name:	Printed Name:
Comments/Special Instructions:	Company:	Company:	Company:
	Date: Time:	Date: Time:	Date: Time:
	Received by: (Signature)	Received by: (Signature)	Received by: (Signature)
	Printed Name:	Printed Name:	Printed Name:
	Company:	Company:	Company:
	Date: Time:	Date: Time:	Date: Time:

Limits of Liability: ARI will perform all requested services in accordance with appropriate methodology following Standard Operating Procedures and our Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI releases ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the client.

Chain of Custody

CLIENT ____

DATE ____

Parametrix, Inc.

Parametrix, Inc.

Client: ________________ Project: ________________

Sample ________________ Site ________________

Date __________ Time __________ Sampler __________

Analysis ________________________________

Comments: ________________________________

Well #: ______
Sample #: ______

Groundwater Sampling Field Data Sheet

Project Number: ______ Date: ______
Project Name: ______ Location: ______
Project Address: ______ Sampled By: ______
Client Name: ______ Purged By: ______

Casing Diameter: 2" ______ 4" ______ 6" ______ Other ______

Depth to Water (feet): ______ Purge Volume Measurement Method: ______
Depth of Well (feet): ______ Date Purged: ______
Reference Point (surveyors notch, etc.): ______ Purge Time (from/to): ______
Date/Time Sampled: ______

Purge Volume Calculation: $(\pi r^2 h)(7.48\ \text{gal/ft}^3)$(5 casing volumes)
Purge Volume (gallons) for: 2" = (0.80)(h); 4" = (3.26)(h); 6" = (7.40)(h)
Calculated Purge Volume (gallons): ______ Actual Purge Volume (gallons): ______

TIME (2400 hr)	CUMULATIVE VOLUME (gal)	PH (units)	Ec (μmhos/cm 25° c)	COLOR (visual)	TURBIDITY (visual)	ODOR	OTHER

Purging Equipment: ______ Sampling Equipment: ______

Laboratory: ______ Date Sent to Lab: ______
Chain-of-Custody (yes/no): ______ Field QC Sample Number: ______
Shipment Method: ______ Split with (name(s)/organization(s)): ______

Well Integrity: ______
Remarks: ______

Signature: ______ Page ______ of ______

Field Report/Well Data

DATE	JOB NO.
PROJECT	
LOCATION	
CONTRACTOR	OWNER
WEATHER	TEMP °at AM °at PM
PRESENT AT SITE	

TO:

THE FOLLOWING WAS NOTED:

WN (WELL NUMBER)	TIME	DTW (DEPTH TO WATER)	MP (MEASURE POINT)	SU (STICK UP OF WELL CASING)	TD (TOTAL DEPTH OF WELL)	WD (WELL DIAMETER)

TOC (Top of Locking Casing) TOW (Top of Well Casing)

Parametrix, Inc.

COPIES TO:

SIGNED

Field Report

DATE	JOB NO.		
PROJECT			
LOCATION			
CONTRACTOR	OWNER		
WEATHER	TEMP	° at ° at	AM PM
PRESENT AT SITE			

TO

THE FOLLOWING WAS NOTED:

COPIES TO:

SIGNED

Parametrix, Inc.

Sample Analyses Tracking Report

PAGE ______ OF ______

PROJECT NAME ________________________________ PROJECT NO. ____________________ CLIENT ____________________________

PMX SAMPLE NO.	SAMPLE DESCRIPTION	SAMPLING DATE/TIME	DATE SAMPLE SHIPPED	DATE/TIME LAB CONTACTED FOR SHIPMENT	DATE ANALYTICAL DATA RECEIVED	LABORATORY INVOICE NO.	DATE QUALITY ASSURED	DATE DATA SENT TO CLIENT	COMMENTS

APPENDIX B

Calculation of Hardness and pH Dependent Surface Water Standards

CALCULATION OF HARDNESS DEPENDENT SURFACE WATER STANDARDS

Parameters for calculating Freshwater Dissolved Metals Criteria that are hardness-dependent are provided in the table on the following page. Calculate actual standard per Appendix C.

Maximum Criteria Concentration: $CMC = CF \times \exp\{m_A[\ln(\text{hardness})]+b_A\}$

Continuous Criteria Concentration: $CCC = CF \times \exp\{m_C[\ln(\text{hardness})]+b_C\}$

With hardness expressed in mg/L.

Conversion factors (total versus dissolved concentrations) are also attached.

United States Environmental Protection Agency
Office of Water 4304
EPA 822-Z-99-001
April 1999

EPA

National Recommended Water Quality Criteria–Correction

Appendix A - Conversion Factors for Dissolved Metals

Metal	Conversion Factor freshwater CMC	Conversion Factor freshwater CCC	Conversion Factor saltwater CMC	Conversion Factor saltwater CCC[1]
Arsenic	1.000	1.000	1.000	1.000
Cadmium	1.136672-[(ln hardness)(0.041838)]	1.101672-[(ln hardness)(0.041838)]	0.994	0.994
Chromium III	0.316	0.860	--	--
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	1.46203-[(ln hardness)(0.145712)]	1.46203-[(ln hardness)(0.145712)]	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	--	--	0.998	0.998
Silver	0.85	--	0.85	--
Zinc	0.978	0.986	0.946	0.946

Appendix B - Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	m_A	b_A	m_C	b_C	Freshwater Conversion Factors (CF)	
					Acute	Chronic
Cadmium	1.128	-3.6867	0.7852	-2.715	1.136672-[ln (hardness)(0.041838)]	1.101672-[ln (hardness)(0.041838)]
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960
Lead	1.273	-1.460	1.273	-4.705	1.46203-[ln (hardness)(0.145712)]	1.46203-[ln (hardness)(0.145712)]
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.52	--	--	0.85	--
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

Appendix C - Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC calculated using the following equation:

$$CMC = \frac{0.275}{1 + 10^{7.204-pH}} + \frac{39.0}{1 + 10^{pH-7.204}}$$

In situations where salmonids do not occur, the CMC may be calculated using the following equation:

$$CMC = \frac{0.411}{1 + 10^{7.204-pH}} + \frac{58.4}{1 + 10^{pH-7.204}}$$

2. The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CCC calculated using the following equation:

$$CCC = \frac{0.0858}{1 + 10^{7.688-pH}} + \frac{3.70}{1 + 10^{pH-7.688}}$$

and the highest four-day average within the 30-day period does not exceed twice the CCC.

Federal Freshwater Dissolved Metal Criteria That Are Hardness Dependent 07-May-02

Data Values Per EPA 822-Z-99-001 4/99

Parameter	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
mA	1.1280	0.8190	0.9422	1.2730	0.8460	1.7200	0.8473
bA	-3.6867	3.7256	-1.7000	-1.4600	2.2550	-6.5200	0.8840
mc	0.7852	0.8190	0.8545	1.2730	0.8460	NA	0.8473
bc	-2.7150	0.6848	-1.7020	-4.7050	0.0584	NA	0.8840
Acute CF	Calc	0.3160	0.9600	Calc	0.9980	0.8500	0.9780
Chronic CF	Calc	0.8600	0.9600	Calc	0.9970	1.0000	0.9860

Hardness	Cadmium Conversion Factors (CF)		Lead Conversion Factors (CF)	
(mg/L)	Acute	Chronic	Acute	Chronic
10	1.0403	1.0053	1.1265	1.1265
20	1.0113	0.9763	1.0255	1.0255
30	0.9944	0.9594	0.9664	0.9664
40	0.9823	0.9473	0.9245	0.9245
50	0.9730	0.9380	0.8920	0.8920
60	0.9654	0.9304	0.8654	0.8654
70	0.9589	0.9239	0.8430	0.8430
80	0.9533	0.9183	0.8235	0.8235
90	0.9484	0.9134	0.8064	0.8064
100	0.9440	0.9090	0.7910	0.7910
110	0.9400	0.9050	0.7771	0.7771
120	0.9364	0.9014	0.7644	0.7644
130	0.9330	0.8980	0.7528	0.7528
140	0.9299	0.8949	0.7420	0.7420
150	0.9270	0.8920	0.7319	0.7319
160	0.9243	0.8893	0.7225	0.7225
170	0.9218	0.8868	0.7137	0.7137
180	0.9194	0.8844	0.7054	0.7054
190	0.9171	0.8821	0.6975	0.6975
200	0.9150	0.8800	0.6900	0.6900

Calculated Acute Freshwater Criteria, ug/L
Based on Dissolved Metal Concentration

Hardness (mg/L)	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
10	0.350	86.4	1.54	4.91	66.8	0.066	16.7
20	0.744	152	2.95	10.79	120	0.22	30.0
30	1.16	213	4.32	17.04	169	0.43	42.2
40	1.58	269	5.67	23.51	216	0.71	53.9
50	2.01	323	6.99	30.14	260	1.05	65.1
60	2.45	375	8.31	36.88	304	1.43	76.0
70	2.90	425	9.60	43.71	346	1.87	86.6
80	3.35	475	10.9	50.61	388	2.35	97.0
90	3.80	523	12.2	57.57	428	2.88	107
100	4.26	570	13.4	64.58	468	3.45	117
110	4.73	616	14.7	71.63	508	4.06	127
120	5.20	662	16.0	78.72	546	4.72	137
130	5.67	706	17.2	85.83	585	5.42	146
140	6.14	751	18.5	92.97	622	6.15	156
150	6.62	794	19.7	100.13	660	6.93	165
160	7.10	837	20.9	107.31	697	7.74	175
170	7.58	880	22.2	114.50	734	8.59	184
180	8.06	922	23.4	121.70	770	9.48	193
190	8.55	964	24.6	128.92	806	10.4	202
200	9.03	1005	25.8	136.14	842	11.4	211

Calculated Chronic Freshwater Criteria, ug/L
Based on Dissolved Metal Concentration

Hardness (mg/L)	Cadmium	Chromium III	Copper	Lead	Nickel	Silver	Zinc
10	0.406	11.2	1.25	0.191	7.41	NA	16.8
20	0.679	19.8	2.26	0.421	13.3	NA	30.2
30	0.918	27.6	3.20	0.664	18.8	NA	42.6
40	1.14	35.0	4.09	0.916	24.0	NA	54.4
50	1.34	42.0	4.95	1.17	28.9	NA	65.7
60	1.53	48.8	5.79	1.44	33.8	NA	76.6
70	1.72	55.3	6.60	1.70	38.5	NA	87.3
80	1.90	61.7	7.40	1.97	43.1	NA	97.8
90	2.07	68.0	8.18	2.24	47.6	NA	108
100	2.24	74.1	8.96	2.52	52.0	NA	118
110	2.40	80.1	9.72	2.79	56.4	NA	128
120	2.56	86.1	10.5	3.07	60.7	NA	138
130	2.72	91.9	11.2	3.34	64.9	NA	148
140	2.87	97.6	11.9	3.62	69.1	NA	157
150	3.02	103	12.7	3.90	73.3	NA	167
160	3.17	109	13.4	4.18	77.4	NA	176
170	3.31	114	14.1	4.46	81.5	NA	185
180	3.45	120	14.8	4.74	85.5	NA	194
190	3.60	125	15.5	5.02	89.5	NA	204
200	3.73	131	16.2	5.31	93.5	NA	213

Ammonia Freshwater Criterion (mg/L)

pH	CMC	CCC
5.5	38.2	3.68
5.6	38.1	3.67
5.7	37.8	3.66
5.8	37.5	3.65
5.9	37.2	3.64
6.0	36.7	3.63
6.1	36.2	3.61
6.2	35.5	3.59
6.3	34.7	3.56
6.4	33.7	3.52
6.5	32.6	3.48
6.6	31.3	3.43
6.7	29.8	3.36
6.8	28.0	3.29
6.9	26.2	3.19
7.0	24.1	3.08
7.1	21.9	2.96
7.2	19.7	2.81
7.3	17.5	2.65
7.4	15.3	2.47
7.5	13.3	2.28
7.6	11.4	2.08
7.7	9.6	1.87
7.8	8.1	1.66
7.9	6.8	1.46
8.0	5.6	1.27
8.1	4.6	1.09
8.2	3.8	0.94
8.3	3.1	0.80
8.4	2.6	0.67
8.5	2.1	0.57